# EFFICACY OF ROPIVACAINE AND LIGNOCAINE HYDROCHLORIDE FOR EPIDURAL ANAESTHESIA IN BUFFALOES

**T H E S I S**

**Submitted**

**In partial fulfillment of the requirements for the Degree of**

## MASTER OF VETERINARY SCIENCE

**IN**

**VETERINARY SURGERY AND RADIOLOGY**

**BY**

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## DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled **"Efficacy of Ropivacaine and Lignocaine Hydrochloride for Epidural Anaesthesia in Buffaloes"** or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/publication of any University or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

**Date: / 09/ 2017**

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**Mr. Shaikh Azmat Shaikh Maulana**has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled, **"Efficacy of Ropivacaine and Lignocaine Hydrochloride for Epidural Anaesthesia in Buffaloes"** submitted by him is the result of research work sufficient to warrant its presentation to the examination in the subject of **VETERINARY SURGERY AND RADIOLOGY**for the award of **MASTER OF VETERINARY SCIENCE** degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

We also certify that the thesis or part thereof has not been previously submitted by him for a degree of any other University.

**Place: Udgir**
**Date: / 09/ 2017**

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## CERTIFICATE

This is to certify that the thesis entitled, **"Efficacy of Ropivacaine and Lignocaine Hydrochloride for Epidural Anaesthesia in Buffaloes"** submitted by **Mr.Shaikh Azmat Shaikh Maulana** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE** has been approved by the Student's Advisory Committee after examination in collaboration with the External Examiner.

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**(Shaikh A.M.)**

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| | | |
|---|---|---|
| % | - | Per cent |
| @ | - | At the rate of |
| ± | - | Plus or minus |
| < | - | Lesser than |
| > | - | Greater than |
| $^{0}$F | - | Degree Farenheit |
| Dl | - | Deciliter |
| g | - | Gram |
| kg | - | Kilogram |
| mg | - | Milligram |
| ml | - | Milliliter |
| µl | - | Micro liter |
| µg | - | Microgram |
| No. | - | Number |
| Sl. | - | Serial |
| viz. | - | Namely |
| *et al* | - | Co workers |
| P | - | Level of significance |
| SE | - | Standard Error |
| SD | - | Standard deviation |
| IU | - | International unit |
| CSF | - | Cerebrospinal fluid |
| HCl | - | Hydrochloride |
| PCV | - | Packed Cell Volume |
| TLC | - | Total leukocyte count |
| DLC | - | Differential leukocyte count |
| IVF | - | Inter Vertebral Space |
| Gr | - | Grade |
| Tech | - | Technique |

# CHAPTER 1

## INTRODUCTION

The buffalo occupy a unique place in the agriculture economy of our country. Indian buffalo have an immense potential for food and power. India accounts for worlds 58 % of buffalo population, which are commonly affected with surgical condition *viz.* ruptured bladder, prolapse of vagina and uterus, dystocia, volvulus, strangulation,fracture and,ruminal impaction. Majority of these ailments require painless surgical correction and management, which can be accomplished under epidural analgesia (Moulvi *et al*., 2011b).

The majority of the surgical procedures in ruminants are performed using local analgesics and amongst different local anaesthetic techniques epidural analgesia is preferred over general anaesthesia in large animal in our country because of non-availability of advanced infrastructure under field conditions and also due to its usefulness in older animals with poor surgical risk (Hall and Clarke, 1983). Apart from this, several other features of local anaesthesia particularly render it useful in veterinary practice.

Epidural anaesthesia and analgesia techniques are relatively simple to implement and allow the use of reduced amounts of analgesic medications as compare to systemic administration and thereby reduction in the costs and side effects of the drugs used. The awareness of animal pain and distress is increasingly high in productive animals and utilization of epidural techniques may play a critical role in pain management for veterinary patients. When compare to general anaesthesia local anaesthesia is safe and cheaper (Michael and Cousins, 2009). Also amongst the various local anaesthetic methods available to anaesthetize various regions of the body locally in buffaloes, the epidural anaesthesia is especially important since various surgical procedures involving the tail, perineum region, rectum, vaginal and vulva, udder and scrotum can be performed under this anaesthesia very effectively (Tyagi and Singh, 1996). Moreover, in adult animals many of the operations are required to be performed in standing position that eliminates the dangers associated with forcible casting and

restraint and prolonged recumbency. It provides particularly in buffaloes a useful pain relief, even beyond the expectations.

Local anaesthetics indiscriminately block sensory, sympathetic and motor fibers. Local anaesthetic solution when injected into epidural space depresses the axonal conduction and affects sympathetic, sensory and motor fibers in order of decreasing sensitivity. This nonspecific action may result in handling weakness when motor fibers are affected and in buffalo and horses may induce marked ataxia or even recumbency. The standing position of animal would be advantageous for surgery to avoid complications and hence, drug for epidural analgesia that can induce blockade of sensory fibers without affecting autonomic or lower motor neurons is preferable.

A true local analgesic must produce a reversible depression in the conduction of nerve impulses with least systemic toxicity. The interference in the conduction along with damage to nerve cells is a major disadvantage of many local analgesics. Any evidence of structural damage to the fibers of the nerve cells caused by particular local analgesic is an unfavorable characteristic of that particular local analgesic.

In recent year various local analgesics have been synthesized with difference in potency and toxicity. This drug apart from having local analgesic effects has also certain undesirable actions on other body system. The relative toxicity and potency of these drugs have determined their superiority over others (Yagiela, 1985).

All local analgesics after being absorbed from the site of injections reach to the liver via systemic circulation for their detoxification (Vickers *et al.,* 1984). Greater being the toxicity of local analgesics, more it will hamper the liver function. After being metabolized in the liver, these drugs appear in the urine for their elimination (Lumb and Jones, 1984). Through circulation these drugs may also pas from the spleen, liver and hence likely to affect the haemogram.

Onset and duration of analgesia induced by local depends upon their chemical structure, site of injection and dose rate and route of administration of local analgesics. Large numbers of local analgesics are in use for epidural

analgesia in large animals with variable degree of toxicity and efficiency. Many other drugs besides local anaesthetics have been used via the epidural route in human and veterinary medicine to provide analgesia.

Different local anaesthetics were used for epidural anaesthesia. Most popular local anaesthetics used in India being lignocaine and bupivacaine. Lignocaine hydrochloride (N-diethylamino acetyl 2, 6-xylidine hydrochloride) was successfully used to produce epidural anaesthesia in cattle (Grubb *et al*., 2002) and buffaloes (Hussain and Kumar, 1988). The drawback of lignocaine is its intermediate duration of action and that of bupivacaine is fatal cardiac and CNS toxicity after accidental intravascular injection. For this reason, there has been a search for alternative drugs with desirable blocking properties and greater margin of safety. Ropivacaine is the newer long acting amide local anaesthetics which has a wide margin of safety compared to bupivacaine, with all its advantages (Casati and Putzu, 2005).

Ropivacaine has been recently introduced in India and since it has all the advantages of bupivacaine with less cardiac toxicity (Wille, 2004) andropivacaine was effective and safe local anaesthetic for epidural anaesthesia in caprine(Singh *et al*., 2005).

Since there is a controversy regarding the effectiveness of ropivacaine as a local anaesthetic for epidural anaesthesia in large ruminants and also ropivacaine being recently introduced, there is a need to compare the most dependent and trusted local anaesthetic lignocaine with ropivacaine for epidural anaesthesia. Therefore the present study was conducted in buffaloes with following objectives.

1. To investigate and compare the efficacy and analgesic effect of ropivacaine hydrochloride for epidural anaesthesia in buffalo.
2. To evaluate physiological and clinical changes induced before, during and after epidural administration of both the agents.
3. To perform the surgical treatment under epidural anaesthesia with each of the two agents.

# Chapter 2

# REVIEW OF LITERATURE

Local anaesthetics are the drugs which reversibly blocks impulse conduction along nerve axons and other excitable membranes that utilize sodium channels as the primary means of action potential generation. Cocaine is the first such agent, were isolated by Niemann in 1860 and for next 30 years cocaine was the only anaesthetic drug available. Einhorn in 1905 synthetized Procaine, which became the dominant local anaesthetic for next 50 years. Since 1905, many local anaesthetics are ideal, and development of newer agents continued.

General anaesthesia and associated complication may be avoided by the use of epidural anaesthesia in ruminants, as most of the operations in abdomino-pelvic region can be accomplished in standing animals (Cousins and Mather, 1984). Epidural anaesthesia can be achieved by introduction of a local anaesthetic solution into the epidural space. The drug diffuses into subarachnoid space and temporarily paralyses the spinal nerve roots at contacts, resulting in analgesia of the tissue innervated by the nerve (Booth, 1988). Technique of epidural administration of drugs is easy and within the reach of most of the clinicians. Numerous investigations have proven the efficacy of epidural analgesia in various animal species (Hendrickson *et al*., 1996).

## 2.1 Surgical anatomy of caudal spinal canal in buffalo

From the medulla ,the spinal cord runs posteriorly in the vertebral canal.In domestic animals, it extends to the lumbosacral junction.It is sourrounded by the meninges which support and protect it.From without inward ,they are the dura mater,arachnoid, pia matter.The spinal fluid is found in the subarchnoid space.Afferent fibers arriving at the cord through the dorsal roots carry sensory impulses,which are conducted to motor reflex centers within the cord to muscles and glands.Ascending and descending tracts within the cord connect the higher centers and the various cord segments with each other.

The epidural space lies within the vertebral canal and sourrounds the spinal cord and its enveloping membranes. It is bounded internally by the durameter.Externally,it is limited by vertebral bodies and arches,intervertebral discs, and associated ligaments.The periosteum of the vertebrae is a continuation of the outer layer of the cerebral dura and joins with the internal meningeal layer of the dura mater at the foramen magnum.The epidural space terminate at this point.The space contains spinal nerve roots, blood vessels,spinal membranes within which are the cord and associated spinal fluid and fat and areolar tissue in which cord is suspended. Major blood vessels of significance within the spinal canal are the paired vertebral venous sinuses,which extended longitudinally along the floor of the vertebral canal. Since they anastomose freely with other veins draining the trunk and with the azygos vein, they provide an aitrnative route for venous return which bypasses the caval system .They may be inadvertently punctured during spinal injections and provide a route by which spinal anaesthetics rapidly enter the systemic circulation.In addition to these vessels,branches of cervical,intercostal,lumbar and iliolumbar arteries enter the canal via intervertebral foramina.

### 2.2 Drugs pharmacology and clinical properties

The local anaesthetics are mainly classified into esters and amides (Katzung, 2004 and Hale, 2007). The more basic amide agents (lidocaine,mepivicaine,bupivacaine) have a faster onset of action and give more profound analgesia than the ester agents (procaine,propoxyline,benzocaine).The amide agents also have longer duration of action due to protein binding (Hale,20087).Also,amides are not metabolized to p-aminobenzoicacid,agent responsible for allergic reactions.Hence ,allergic reactions to agents of the amide group are extremely rare and are less likely to result in allergic reaction than the ester agents(Katzung,2004).

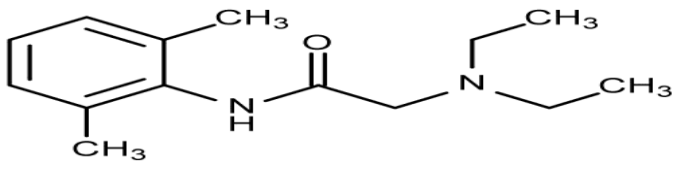
Potency, onset of action,duration of action and relatively blockade of sensory and motor fibers are important clinical properties of local anaesthetics,These clinical properties are related to the physiochemical properties of lipid solubility pka and protein binding (Feyh,1993).

### 2.2.1 Lignocaine

Lignocaine is the first amino amide-type local anaesthetics was first synthesized under the name xylocaine by Swedish chemist Nils Lofgren in 1943 (Katzung, 2004). His colleague bengt Lundqvist performed the first injection anesthesia experiments on himself(Lofgren, 1948).

Among all local anaesthetic agents lignocaine is the most popular drug in use today. It has a molecular weight of 234.3 and its empirical formula is C14H22N2O. as with all local anaesthetic lignocaine has a common formula consisting of a lipophilic end and intermediate chain and a hydrophilic end. Lignocaine base is a white crystalline powder and has a melting point of 66-69*C. the base is slightly soluble in water whereas the acid salt of base lignocaine Hcl is highly soluble in water. It is the form of lignocaine used for administration by injection (Bouloux, 1998).

Lignocaine is approximately 95% metabolized (dealkylated) in the liver by cytochrome P3A4 to the pharmacologically active metabolites monoethylglycinexylidide (MEGX) and then subsequently to the inactive glycine xylidide (Flomenbaun *et al.,* 2006).Lignocaine alters signal conduction in neurons by blocking the fast voltage gated sodium (Na+) channels in the neuronal cell membrane that are responsible for signal propagation (Catterall, 2002). With sufficient blockade the membrane of post synaptic neuron will not depolarize and thus fail to transmit and action potential. This creates the ananesthetic effect by not merely preventing pain signals from propagating to the brain rather by stopping them before they begin.



### 2.2.1.1 Use of Lignocaine HCl for epidural anaesthesia in clinical cases

Lignocaine (2%) had been used to induce posterior epidural anaesthesia at the dose rate of 5-10 ml or 0.2 mg/kg in cattle (Ko *et al*., 1989) and at the dose rate of 6-8 ml in horse (Greene and Thurmon, 1985). In adult sheep, 2-5 ml of 1 to 2% lignocaine had been used by Lumb and Jones (1984) to induce sacrococcygeal epidural analgesia. Rajankutty *et al*. (1985) and Makaday *et al*. (1990) used 2% lignocaine for epidural analgesia in goats at the dose rate of 0.2, 0.4 and 0.8 ml/kg body weight.

Buchloz and Koever (1948) stated principal sites of action of local anaesthetic drugs after epidural injection were spinal nerves,that are blocked distal to the dural sheaths after leaving the intervertebral foramina,resulting in multiple paravertebral block.

Frank (1964) stated epidural analgesia indicated to control straining in replacing prolapsed vagina and uterus and for more painful operation such as cesarean section in animals.

Mulling *et al.* (1966) performed high epidural anaesthesia for operation on cow teats using various anaesthetic solutions. For relatively short operations on the teats, 1 and 2% solution of butamin hydrochloride (80 ml and 50 ml respectively) and 2%solution of procaine HCl (100 ml) appeared to be suitable. For prolonged surgical interventions a 2% solution of lignocaine HCl (60 ml) was recommended.

Cohen (1968) concluded that local anaesthetics were highly soluble in lipids.Myelin covering the neurons contained lipids therefore,heavy myelination,increased the uptake of local anaesthetics in the neuronal tissue when given epidurally.

Deshpande *et al.* (1969) used 5 ml of 2% lignocaine hydrochloride as an epidural anaesthetic to perform penectomy in a case of urethral rupture in bullock.

Bhokre and Deshpande (1979) performed experimental study on anaesthesia and relaxation of bovine penis through first intercoccygeal epidural injection. 5% procaine HCl solution with adrenaline 1:80,000 and 2% lignocaine hydrochloride solution with adrenaline 1:10,000 was used in 24 bovines. 25% of the cases remained in standing position with complete relaxation of penis was observed in 62.5% cases and animal showed severe locomotor incoordination and recumbency , while failure was observed in12.5% cases. The commencement of exposure of penis started from 8 to 65 minutes.

Dallman and Mann (1984) used lignocaine for epidural anaesthesia in dogs and cat for ovariohysterectomy, hernia, rectal prolapse, cystic and urethral calculi and reduction and management of coxo-femoral luxation

Nigam *et al.*(1983) estimated plasma levels of lignocaine hydrochloride following local and regional analgesia in 4 groups comprising of 5 buffalo calves each.2 lignocaine was used at the dose rate of 2mg/kg to produce inverted L block in left paralumbar fossa (group 1) para vertebral block (group 2) epidural injection through first intercoccygeal space (group 3) and spinal analgesia through the lumbar space (group 4) .The highest plasma concentration recorded in 10 minutes after lidocaine injection was 13.25 microgram/ml in spinal analgesia (group 4) and 11.25 microgram/ml in spinal analgesia (group 3). No toxic signs were reported in any of the group.

Hussian *et al.* (1987) reported anaesthetic management of prolapse of vagina and uterus in bovines by epidural injection of lignocaine hydrochloride 2% solution alone (0.05 ml/kg), its four repeated injection through indwelling catheter or lignocaine hydrochloride 2% solution followed 10 minutes later by amyl alcohol 90% (0.01 ml/kg). The analgesia lasted for 79.25 ± 5.20 minutes in animal given lignocaine alone, 272.25 ±34.50 minutes in animals given four repeated injection of lignocaine and 16.50 ± 4.25 days in those given lignocaine followed by amyl alcohol. No complications were observed in any of these treatments.

Ko *et al*. (1989) studied the effects of epidural administration of lignocaine or xylazine in 6 Holstein cows (7 day post-estrus) were subjected to sacrococcygeal epidural injection of lignocaine (0.2 mg/kg) and xylazine (0.05

mg/kg) suspended in 5 ml of saline. In the xylazine group, uterine motility significantly increased at 20 minutes post treatment, peaked at 30 minutes, and gradually decreased to non-significant levels at 50 minutes post. treatment when compared with the lignocaine and control group. Additionally, xylazine produced a higher degree and longer duration of perineal analgesia than lignocaine.

Fikes *et al.* (1989) administered lidocaine (0.35 mg/kg) or xylazine (0.35 mg/kg) into epidural space of six ponies to compare their effectiveness as epidural analgesia. Xylazine produced analgesia of significantly longer duration (247 ± 58 minutes) than that produced by an equal dose of lidocaine (135 ± 22 minutes). They reported mild transient ataxia in all ponies with both treatment.

Nowrouzian *et al.* (1991) field trials with epidural xylazine and lignocaine hydrocholoride in cattle indicated prolonged duration and higher speed to anatomical areas with no complications either during surgery or afterwards.

Ko *et al*. (1993) used the combination of lignocaine HCl (0.5 mg/kg) and xylazine(0.07 mg/kg) epidurally for caesarean section in pigs.

Caulk *et al. (1993)* evaluated the efficacy of xylazine during epidural analgesia for caesarean section in cattle.They concluded that epidural xylazine HCL administered at the recommened dose rate to healthy animals can be used as a technique to provide surgical analgesia and sedation for caesarean section in the cow .

Grubb *et al.* (1993) evaluated sacrococcygeal epidural anaesthesia in llamas using lignocaine (0.22 mg/kg), xylazine (0.17 mg/kg) and a combination of lignocaine - xylazine (0.22 mg/kg and 0.17 mg/kg) respectively. Time to onset of analgesia was not different (P> 0.05) between lidocaine (3.16 ± 0.31 minutes) and lignocaine/xylazine (3.50± 0.56 minutes), however both groups were different than xylazine (20.67 ± 3.37 minutes). Duration of analgesia was different in (P < 0.05) among all groups (lidocaine 71.00 ±6.15; xylazine 186.83 ± 14.86; lidocaine/xylazine 325.83 ± 29.39 minutes). Mild sedation occurred in four llamas given xylazine alone. Lidocaine/xylazine caused mild sedation in two llamas

and moderate sedation in one llama. No significant changes in pulse or respiratory rate occurred among drugs however,it did occur over time with all drugs.

Morrison *et al.* (1994) studied efficacy and kinetics of extradural ropivacaine and bupivacaine (0.5%). They reported that all the three solutions produced extradural block which was largely effective within 30 minutes. The time required for onset of analgesic effect in 0.5 % ropivacaine group was varied between 5 and 20 minutes. In the 1% ropivacaine group the time required for onset of analgesic effect in 1% group was between 5 and 19 minutes whereas the time required for onset of analgesic varied both 5 and 20 minutes in 5% bupivacaine group. They further reported that duration of analgesic effect was significantly longer in 1% ropivacaine group than 0.5% group.

Amresh Kumar (1997) stated that epidural anaesthesia were indicated in amputation of tail, laceration of vulva and vagina, rectovaginal fistula, reduction of prolapsed vagina, uterus and rectum and cesarean operation.

Grubb *et al.* (2002) performed caudal epidural anaesthesia on cows using 2% lignocaine (0.22 mg/kg; 5.5 ml/500kg ), 10% xylazine (0.05 mg/kg diluted to 5.5 ml/500kg with sterile water) and 2% lignocaine with 10% xylazine (0.22 mg/kg, 0.05 mg/kg; total volume of 5.7 ml/500kg) and concluded, for relatively longer duration obstetrical and surgical procedures lignocaine and xylazine combination was suitable with longer duration of analgesia (302.8 ± 11.0 minutes) compared to lignocaine alone (81.8 ± 11.8 minutes) and xylazine alone ( 252 ± 18.9 minutes).

Lee and Yamada (2005) used modified method for epidural anesthsia in standing cattle for flank surgery in which fixed volume of xylazine and lidocaine were injected and study conclude that the modified epidural anesthetic technique with injection of fixed volume of xylazine and lidocaine appeared to be adequate method for anesthesia of standing cattle undergoing flank surgery.

Kamiloglu *et al*. (2005) studied the epidural administration of a xylazine – lidocaine combination accompanied by xylazine sedation which provided satisfactory analgesia for some surgical procedures on 10 calves.The study revealed that the combination of epidural xylazine-lidocaine with sedation was

highly satisfactory for surgery of the lower urinary tract and the perineal region whereas it was less so for surgery of the umbilical area.

Hiraoka *et al*.(2007) described the successful use of modified dorsolumbar epidural anaesthesia with a fixed volume of anaesthetic in a bovine referral center.Group I received 1ml of xylazine and 3ml of lidocaine while Group II received 0.5 ml of xylazine and 3ml of lidocaine by modified dorsolumbar epidural anaesthesia .The surgeries in groups I and II began about 12 min. after the epidural administration of a mixed anaesthetic solution and lasted for about 36 minutes .Twenty cattle from Group I and one cow from Group II showed light sedation after epidural administration of a mixed anaesthetic .Analgesia was sufficient for flank surgery in almost of all the cattle.

Farshid *et al.* (2007) evaluated analgesic and cardiopulmonary parameters in donkeys on epidural administration of 2% lidocaine 0.22 mg /kg 2% xylazine (0.17 mg/kg) and 2% xylazine (0.17 mg/kg) 10% ketamine (1mg/kg) combination. Results suggested that the combination of xylazine and ketamine (0.17mg/kg and 1mg /kg respectively) induced analgesia with rapid onset longer duration and minimum cardiopulmonary change to xylazine compared to xylazine or lidocaine alone. Clinical point of view this combination at these doses is not suitable for standing surgeries of hindquarters in donkey due to unacceptable likelihood of recumbency.

Bigham and Shafei (2008) used lidocaine with distilled water and lidocaine with magnesium sulphate epidurally in sheep. The onset and duration of analgesia using Lidocaine + $MgSO_4$ significantly prolonged ($p < 0.01$) 4.57 $\pm$1.27and 174.0 $\pm$ 12.19 min, respectively as compared to 2.07 $\pm$ 0.73 and 53.42 $\pm$ 4.70 respectively using lidocaine + distilled water. They further reported that Body temperature, Heart rate and Respiratory rate were not significantly different vs base line values throughout the study. Compared time of onset and duration of analgesia produced concluded by either a 2% lignocaine (0.22mg/kg) -1ml of 10% magnesium sulphate or 2% lignocaine-1ml distilled water combination administration at caudal epidural space of horse and concluded that onset of analgesia was faster in lignocaine –distilled water group (2.38±0.54 minutes) then lignocaine –magnesium

sulphate group (4.62±0.54 minutes) and significantly longer duration of analgesia observed in lignocaine-magnesium sulphate group (186±7.0 minutes) compared to lignocaine distilled water (547.3minutes).

David *et al.* (2009) performed cesarean section under light caudal epidural anaesthesia combined with local infiltration using 2 % lignocaine hydrochloride in left ventro-dorsal site adopting standard protocol.

DeRossi *et al*. (2010) used epidurally hypertonic 5% lignocaine (0.2 mg/kg) or hypertonic 0.5% bupivacaine (0.025 mg/kg) for flank anaesthesia in cows and stated hypertonic lignocaine provided faster onset of anaesthesia and fewer cardiovascular effects, but had a shorter duration of anaesthesia than hypertonic bupivacaine.

Bashir *et al*. (2011) They further reported that none of the animals treated with lignocaine alone showed salivation however animals treated with lignocaine + ketamine showed very mild salivation which became mild by 30 to 45 minutes. In lignocaine treated animals decrease in heart rate was recorded whereas in lignocaine + ketamine treated groups heart rate was increased. However in lignocaine treated group decreased in respiration rate was observed.

Bashir *et al*. (2011) compared hematological and biochemical parameters by using lignocaine (2mg/kg) with and without xylazine (0.5mg/kg) for epidural analgesia and they reported significant decrease in hemoglobin and PCV after 30 min which persisted up to 20 min interval as compared to base value. Similarly TLC values were decreased at 60 min of interval, however significant increase in neutrophils and decrease in lymphocytes percent at 60 to 120 min and concluded that epidural anaesthesia with xylazine as local anaesthetic could be safely used in cow.

Kalim *et al.* (2011) studied clinico-physiological effects of epidural anesthesia using lignocaine(0.5mg/kg) alone and in combination with ketamine (2mg/kg) in cow calves and reported onset of analgesic effect, depth of analgesia, area of desensitization, motor incoordination, heart rate, respiratory rate and rectal temperature at various intervals viz. 5, 10, 20, 30, 45, 60, 90, 120, 150, 180 and

240 minutes after induction of drugs and concluded the onset of analgesia in lignocaine and ketamine combination was fast.

Moulvi *et al.* (2011) studied clinico-physiological effect of epidural anaesthesia using lignocaine alone and in combination with ketamine in cow calves and study revealed that in A group animal decrease in heart rate and respiration rate was recorded whereas, in group B animal heart rate was increased.

Kalim *et al*. (2011) evaluated the efficacy of bupivacaine (Group A) alone and combination with fentanyl (Group B) and medetomidine (Group C) for lumbar epidural analgesia in 15 buffaloes. Hematology revealed significant decrease in Hb (%) ( 9.64 ±0.39, 9.40 ± 0.41) PCV (%) levels in group A,B and C were (28.81 ±1.11, 27.96 ± 1.08); the TLC (1000/cumm) levels in group A,B and C were 8.81 ± 0.51, 8.12 ± 0.46, the DLC levels in group A,B and C were 32.14±0.30, 34.86±0.32, 58.66±0.63, 58.85±0.53, 5.78±0.21, 4.64±0.34, 3.42±0.39, 3.65±0.32, respectively.

DeRossi *et al*. (2013) evaluated the effectiveness and safety of epidural anaesthesia in horses using lidocaine (0.2 mg/kg body weight) alone, combination of lidocaine (0.2 mg/kg body weight) with tramadol (0.5 mg/kg body weight) and lidocaine (0.2 mg/kg body weight) with neostigmine (1.0 micro gram/kg), and concluded duration of analgesia was longer with lidocaine and tramadol combination (210 ± 12 minutes) compared to lidocaine and neostigmine combination (150 ± 35 minutes) or lidocaine alone (70 ± 12 minutes; $P<0.05$). All treatments produced mild to moderate motor block without behavioral changes and no adverse effects were observed in any of the horses.

Biswadeep jena and Abhishek sahoo (2014) conducted study on amputation of tail with varicose veins in a buffalo under caudal epidural anaesthesia by deposition of 5ml of 2% lignocaine hydrochloride local anaesthetic solution in the intercoccygeal space.

Chauhan *et al*. (2015) reported a case of protrusion of genitalia through vaginal tear in buffalo and its successful correction under caudal epidural

anaesthesia by injecting 4ml of 2% lignocaine hydrochloride to control the staining during the surgical procedure.

Ahuja *et al*. (2016)conducted study on management of post partum bilateral prolapse in a crossbred cattle by using caudal epidural anaesthesia with 5ml of 2% lignocaine hydrochloride to reduce straining .

Padheriya *et al.* (2016) conducted study of surgical management of recurrent genital prolapse in Gir cow by pervaginal ovariohysterectomy. They recorded the physiological and hematological parameters rectal temperature, heart rate, respiration rate, Hb, PCV, TLC. The value of rectal temperature 100.4 ±0.26, Heart rate 63.83± 3.44, Respiration rate 22.50±0.84 pre-operative and post-operative values are rectal temperature 101.8±0.33, heart rate 6.50±1.14, Respiration rate 24.50 ±0.99. The preoperative values of Hb (%) 9.93 ±1.37, PCV (%) 36.16±5.22, TLC(1000/cum) 12.78±0.84, post operative value of Hb (%) 12.45±0.63, PCV(%) 45.13±2.95,TLC 9.30±0.20, respectively. The epidural anaesthtic was used to desensitized whole perineal region. Epidural anaesthetic was achieved by the administration of xylazine sedative at the dose rate of 0.05 to 0.1 mg/kg body weight and lignocaine hydrochloride (2 %) was given epidurally in all twelve cows. Epidural anaesthesia was used to blocked sacral and coccygeal nerves so as to desensitize the tail, anus, perineum, vulva and vagina. There was uneventful recovery in four cows.

Padile *et al.* (2008) performed surgical intervention in a case of buffalo with recto-vaginal fistula under epidural anaesthesia using 2% lignocaine HCl.

Patra *et al*. (2015) conducted study on uterine prolapse in a buffalo by using 2% of 7ml of lignocaine hydrochloride through intercoccygeal space to prevent straining and pelvic sensation in order to facilitate further vaginal manipulation.

Rajankutty *et al*. (1985) studied 2% lignocaine with and without hyaluronidase for epidural anaesthesia in goats and the result of the study indicated that, addition of hyaluronidase decrease the time of onset and increase the extent of anaesthesia.

Ramsingh *et al*. (2016) conducted study on stairstep resection and anastomasis of type II rectal prolapse in a cow by using caudal epidural analgesia with 0.05mg/kg xylazine + 2% lignocaine made to 5ml to reduce straing.

Rulcker (1965) studied the use of lignocaine HCl with and without adrenaline for epidural analgesia in cattle. Results indicated that the loss of motor function was greater in the group that received adrenaline. In no instance was sensory function suppressed longer than motor function.

Saifzadeh *et al.* (2007) compared the time of onset, duration of action and extent of analgesia produce by lidocaine/xylaxine combination with those produced by lidocaine and xylazine alone after injection into caudal extradural space of Iranian river buffalo. They concluded the LX combination may offer fast and long lasting anaesthesia/analgesia to perform obstetrical and surgical procedure without the need for re-injection.

Sarker *et al.* (2009) studied caudal epidural anaesthesia with 2% lignocaine hydrochloride with adrenaline (LHA)and 0.5 % bupivacaine hydrochloride (BH) in calve of both sexes. They arrived at conclusion that bupivacaine was better for longer duration of analgesia as compared to lignocaine however lignocaine hydrochloride might be used for rapid analgesia in calves.

Satyanarayana *et al*. (2014) conducted study on management of of tail affections in buffaloes by performing an epidural block by locating the first intercoccygeal space with 8-10ml of 2% lignocaine hydrochloride to achive caudal desensitization of tail.

Seifollah and Amin (2009) compared onset and duration of analgesia in cows on epidural administration of a 2% lignocaine (0.22 mg/kg) - 1 ml of 10% magnesium sulphate with 2% lignocaine - 1 ml distilled water combination and concluded onset of analgesia was faster in lignocaine - distilled water group (2.82 ± 0.33 minutes) then lignocaine - magnesium sulphate (4.76 ± 0.59 minutes) group, the lignocaine - magnesium sulphate group (168 ± 2.6 minutes) produced analgesia of significantly longer duration compared to lignocaine - distilled water (59.8 ± 3.4 minutes).

Sethi *et al*. (2002) employed 2% lignocaine as an epidural anaesthesia for successful correction of vaginal tear and prolapse of urinary bladder in cow.

Sethil kumar *et al*. (2015) conducted study on correction and management of total uterine prolapse in a crossbred cow using 10 ml of lignocaine hydrochloride solution into the sacrococcygeal vertebrae to prevent straining during replacement of the prolapsed organ.

Sharma *et al*. (1992) surgically removed rectal lipoma in bullock under epidural anaesthesia using 5 ml of 2% lignocaine.

Singh *et al.* (2005) evaluated the effects of lignocaine (2.0 mg/kg), xylazine (0.05 mg/kg) and a combination of xylazine and lignocaine (0.05 mg/kg and 2.0 mg/kg, respectively) after lumbar epidural administration in water buffalo calves. They reported that analgesia was faster in xylazine and lignocaine combination group (3.0 ± 0.44 minutes) as compared to lignocaine (4.4 ± 0.40 minutes) and xylazine group (34.0 ± 1.86 minutes). Analgesia of the thorax, flank, inguinal region, hind limbs, perineum and tail was complete in xylazine and lignocaine combination group, however it was mild to moderate in remaining both groups. Ataxia was severe in lignocaine treated group and xylazine + lignocaine group as compared to xylazine treated group. Significantly heart rate, respiration rate, and rectal temperature decreased in xylazine and xylazine + lignocaine. The hematological parameters like hemoglobin, packed cell volume, total leukocyte count decreased in all the groups and biochemical parameters like glucose, cortisol, blood urea nitrogen, creatinine, ALT increased in all the animals.

Skarda and Muir (1996) studied the effect of caudal epidural administered Xylazine hydrochloride solution in mares. They reported minimal sedation ataxia, cardiovascular and respiratory depression in standing mares. heart and respiratory rate, mean arterial blood pressure, PCV, Hemoglobin concentration, and arterial oxygen content and oxygen transport were decreased. Oxygen consumption, Blood temperature and rectal temperature did not change significantly.

Skarda and Muir (2001) studied analgesic, hemodynamics and respiratory effect of administration of ropivacaine hydrochloride in mares. They reported that

epidurally administered ropivacaine induced variable analgesic extending bilaterally coccyx to 52 (three mares), coccyx to 53 and coccyx to 54 (three mare ) with minimum sedation, ataxia, and cardiovascular and respiratory disturbances of mares. They reported that heart rate, respiration rate and rectal temperature decrease from 0 to 180 minutes after administration of ropivacaine hydrochloride in mares.

Sonawane *et al.* (2010) conducted study on fifteen non-discript, healthy male buffalo calve, were animals divided into three group A, B, and C and each group received lignocaine @ 2.2 mg/kg buprenorphine @ 20 µg/kg body weight and xylazine @ 0.05 mg/kg epidurally respectively and they concluded that lignocaine could be used safely along with xylazine and the buprenorphine for obtaining epidural analgesia in bovines.

Tamara *et al.* (2002) studied comparison of lidocaine, xylazine and lidocaine-xylazine for caudal epidural analgesia in cattle in which they compared the time to onset and duration of analgesia and study revealed that lidocaine-xylazine produced analgesia of quicker onset and longer duration than xylazine alone and of longer duration than lidocaine administered alone.

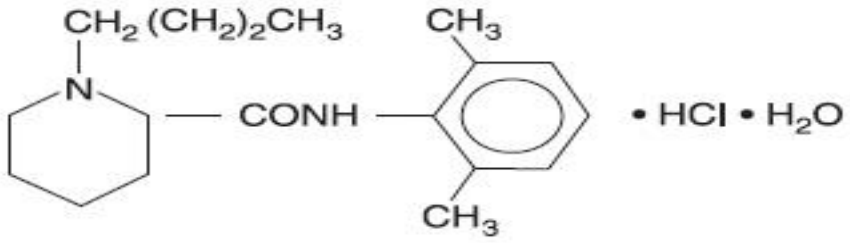
Tanjila Hassan *et al*. (2017) conducted study on correction and management of vaginal prolapse in a cow by buhners technique by using 2% lignocaine hydrochloride solution in first intercoccygeal space to prevent straining, easy control of tail and desensitization of pelvic region which facilitated easy manipulation of vagina into its original position .

Umar and Gapsiso (2008) conducted study effect of xylazine, lignocaine and combination of xylazine and lignocaine for performing epidural anaesthesia in goats and reported the time required for onset of analgesia in in lignocaine, xylazine and xylazine and lignocaine group to be 3.50 ± 0.80, 12.70 ± 3.30 and 4.80 ± 0.70 minutes, action of analgesia was 47.20 ± 2.00, 112.20 ± 10.50 and 131.30 ± 11.80, respectively. The xylazine and combination of xylazine and lignocane injection produce sedation and significant decrease in heart and respiratory. They further reported the effective analgesia produce could be

produced for rumenotomy, cesarean operation, for the treatment of uterine or rectal prolapsed.

### 2.2.2 Bupivacaine

Bupivacaine hydrochloride is (±) -1Butyl-2,6-pipecoloxylidide was first synthesized in 1957 by Ekenstam ,a Scandinavian chemist,and was first introduced into clinical use in 1963. It has longer side chain with four methylene groups on the piperidine ring that is responsible for the different properties of bupivacaine when compared to lignocaine.It has a molecular weight of 288.4,an empirical formula of $C_{15}H_{23}N_2O$ and exists as white crystalline base with a melting point of 251-258˚c.The base is not soluble in water whereas the acid salt and ,bupivacaine hydrochloride is slightly soluble.This form of bupivacaine is used for administration by injection (Boulox,1996),It has the structural formula

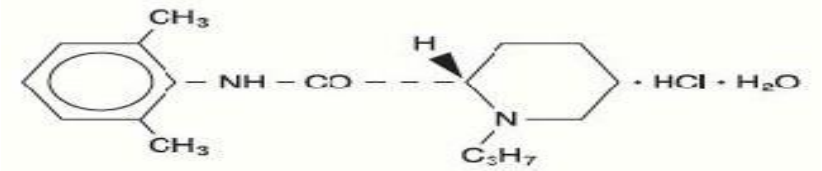



Further, he also described that the other amide local anaesthetics,bupivacaine is metabolized in the liver.Bupivacaine binds to the intracellular portion of sodium channels and blocks sodium influx into the nerve cells,which prevents depolarization. Since pain transmitting nerve fibers tend to be thinner and either unmylinated,the agent can diffuse more readily into them than into thinner and more heavily myelinated nerve fibers like touch ,proprioception,etc.It should be noted ,however,that bupivacaine also blocks specific potassium channels ,an effecting contributing to resting membrane

potential depolarization,It has been pointed out that accidental i/v administration of bupivacaine is more cardiotoxic than other local anaesthetics.Also it has direct effect on cardiac and smooth muscle membrane and indirect effect on autonomic nervous system.(Katzung *et al*.2009)

### 2.2.3 Ropivacaine

Ropivacaine is a long acting regional anaesthetic that is structurally related to bupivacaine, unlike bupivacaine which is racemate, Ropivacaine is the first local anaesthetic to be presented as an almost pure S (-) enantiomer (Jong, 1995) developed for the purpose of reducing the potential toxicity and improving the relative sensory and motor block profiles.




Ropivacaine is a long acting ,amide –type local anaesthetic ,with both anaesthetic and analgesic effects.At high doses it produces surgical anaesthesia and lower doses it produces analgesia(sensory block) with limited and non progressive motor block.The onset and duration of the local anaesthetic effect depend upon on the dose and the site of administration and the addition of a vasoconstrictor.

Ropivacaine has a different blocking effect on nerve fibers at the lowest concentration used, there is a good differentiation between sensory and motor block. As compared to bupivacaine the motor block is often slower in onset, shorter duration and less intense.

Ropivacaine causes reversible blockade of impulse conduction along nerve fibers by preventing the inward movement of sodium ions through the cell membrane. If excessive amounts of the drug reach the systemic circulation,

symptoms and signs of toxicity may appear, emanating from the central nervous and cardiovascular systems.

Healthy volunteers exposed to intravenous infusions showed significantly less cardiac effects after ropivacaine than after bupivacaine. In animal studies ropivacaine has shown a lower cardiac toxicity than bupivacaine.

**2.2.3.1 Use of Ropivacaine HCl for epidural anaesthesia in clinical cases**

Amarpal *et al.* (2007) evaluated the efficacy of 0.75% ropivacaine in buffalo calves using 37.5 mg (5 ml) and 75 mg (10 ml) doses for caudal epidural analgesia and noted that signs of analgesia extended from tail to thorax (T9) in animals given 10 ml of ropivacaine while analgesia was noted at tail, perineum and hind limbs in animals given 5 ml. Other parameters like heart rate, rectal temperature, mean arterial pressure did not change significantly in either group except significant decreased respiratory rate was noticed in animals given 10 ml of ropivacaine. Mean PCV and Hb values ranged between 32.7 $\pm$ 1.45 to 33.3 $\pm$ 1.45 and 10.0 $\pm$ 0.44 to 10.7$\pm$0.32 respectively in group I which increased to 35.3 $\pm$7.42 to 36.4$\pm$5.20 and 11.2$\pm$1.63 to 11.9$\pm$2.48,respectively in group II.

Anubhav *et al.* (2014) compared two doses of ropivacaine hydrochloride for lumbosacral epidural anaesthesia in goats undergoing laproscopy assisted embryo transfer. Group Ist at @ 1.0 mg/kg and Group II @ 0.5 mg/kg. the mean induction time in animal of group I was 12.666 ± 1.994 minutes. In these animals the analgesia extended upto the umbilical region and lasted for 60 minutes. Only two animals in group II were satisfactory induced in 11.333 ± 2.333 minutes. In animals of group I the time taken for regaining the full motor power was significantly long (405 ± 46.314 minutes) when compared to group II goats (95 ± 9.219 minutes). From this study it was concluded that ropivacain did not produce adequate analgesia in most of the goats at 0.5 mg/kg. when it was at 1.0 mg/kg it produced satisfactory regional analgesia lasting for one hour however the prolonged motor loss precludes its use.

Araujo *et al.* (2012) conducted study on cardiopulmonary and analgesic effect of caudal epidural anaesthesia by using ropivacaine. Time required for

onset, duration of analgesia was 15.00 ± 4.00 and 359.00 ± 90.00 minutes respectively. Respiratory rate increased from 0 to 120 minutes and from 120 to 240 minutes. They concluded that ropivacaine 0.75 % @ 0.11 mg/kg BW could be administered by caudal epidural injection to produce prolong bilateral perineal analgesia with minimum ataxia and cardiopulmonary changes in standing cattle.

Brockway *et al.* (1991) compared the effect of extradural 0.5%, 0.75%, 1% ropivacaine to 0.5%, 0.75% bupivacaine and noted that duration of analgesia was increased by increasing concentration of both drugs. Ropivacaine produced slower onset, shorter duration and less intense motor block as compared to same concentration of bupivacaine.

Burm *et al*.(2000) conducted study on epidural infusion of ropivacaine for post operative analgesia after major orthopedic surgery.They concluded that postoperative increase in plasma alpha 1 acid glycoprotein concentrations enhanced the protein binding of ropivacaine and pipecoloxylidide causing divergence of total and unbound plasma concentrations.

Casati and Putzu (2005) reported that ropivacaine had molecular weight of 328.89, Pka of 8.07, plasma protein binding - 95% and lipid solubility 2.9.

Choudhary and Dabus (2013) who achieved caudal epidural analgesia using 5ml 2% lignocaine HCl solution. They reported that no difficulty was encountered for replacement of the prolapse mass and the caudal epidural analgesia with 5ml 2% lignocaine HCl ,was found enough enough to decrease the straining and desensitize the perineum.

Duke *et al*. (2000) conducted study on comparative analgesic and cardiopulmonary effects of bupivacaine and ropivacaine in the epidural space of the conscious dog.They concluded that epidural ropivacaine and bupivacaine at the doses used had mild effects on the cardiopulmonary system and extent of block are similar.

Crosby *et al*. (1998) conducted study on comparision of epidural anaesthesia with ropivacaine 0.5% and bupivacaine 0.5% for caesarean section. They concluded that ropivacaine and bupivacaine 0.5% provided effective

analgesia for caesarean section although supplementation with Iv opiod was commonly required.

Feldman *et al*. (1996) conducted study on antinociceptive and motor blocking efficacy of ropivacaine(0.5%) and bupivacane(0.75%) after epidural administration in the dog.The 0.5% solution produced similar sensory block of the vertebral dermatomes.Duration of dermatomal block was 0.75% bupivacaine was longer than the corresponding ropivacaine concentration.Ropivacaine produced motor block of shorter duration as compared with bupivacaine.

Ganidagli *et al*. (2004) conducted study on comparison of ropivacaine with a combination of ropivacaine and fentanyl for epidural anaesthesia of mares. They concluded that the onset of anaesthesia was significantly more rapid and it lasted significantly longer in the group anaesthetized with the combination of the drug. The surgical comfort scores of the group anaesthetized with the combination were higher than those of group anaesthetized with ropivacaine alone and the quality of intra operative analgesia is assessed by the surgeon was signjficantly improved.

Harkins *et al*. (2000) conducted study on ropivacaine in horse ,its pharmacological responses,urinary detection and mass spectral confirmation .They showed that ropivacaine is a potent local anaesthetic .In the horse that clinically effective doses can be detected in post administration samples by ELISA based screening and that its major post administration urinary metabolite is 3-hydroxyropivacaine.

Jyoti kulkarni *et al*. (2013) conducted study on comparision of ropivacaine with bupivacaine as epidural anesthesia in elderly patients.They concluded that the sensory blockade was comparable in both the ropivacaine and bupivacaine group.Ropivacaine provided less potent motor block with better cardiac stability.So it could be good choice in lower limb surgery in elder patients.

Kamble *et al.* (2016) studied hematological alteration after epidural administration of ropivacaine in buffalo calves. They reported the base value of Hb (g/dl) concentration was found to be 12.60 which decreased non-significantly to 12.37 till 3h and 72 h the value reached up to 12.50g/dl. In PCV (%) estimation, the base line value concentration was 35.80 which non significantly decreased upto 12h (35-35) followed by non significant increase reaching to 35-88. These was non significant decrease in the (g/dl) concentration till 6 h and PCV (%) till 12h.

Katz *et al*.(1993) conducted study on pharmacokinetics of intravenous and epidural ropivacaine in the rhesus monkey.They concluded that ropivacaine biphasic absorption and bioavailability were similar to those of other amide local anaesthetics.The biphasic absorption might be related to partitioning into fat as regional changes in blood flow induced by the drug.

Kutiyala and Chaudhary (2011) concluded that ropivacaine was less lipophilic than bupivacaine and was less likely to penetrate large myelinated motor fibers, therefore it had selective action on the pain transmitting A delta and C nerves rather than Aß fibers, which are involved in motor function.

Lee *et al*. (2002) studied the effect of addition of epinephrine on systemic absorption upon epidural administration of ropivacaine in humans results indicated addition of 5 µg/ml epinephrine to ropivacaine reduced the early systemic plasma concentration of ropivacaine and also decreased the risk of toxicity from systemic absorption.

McClure (1996) stated that ropivacaine is a long acting amide local anaesthetic agent belonging to the pipecoloxylidine group. It is a monohydrate of hydrochloride salt of 1-propyl-2', 6'-pipecoloxylidide and concluded that motor block was less intense, slower in onset and duration when compared to bupivacaine. This together with the lower toxicity compared with bupivacaine, enables ropivacaine to be used for surgical anaesthesia.

Morrison *et al*. (1994) compared efficacy and kinetics of extradural ropivacaine with bupivacaine and they concluded that motor blockade produced by 0.5% ropivacaine was less intense and shorter duration than that with bupivacaine.

Pentyla and Karuna (2016) reported a case of protrusion of urinary bladder and partially involuted uterus through ruptured vagina is post parturient buffalo and its successful correction under caudal epidural anaesthesia by injecting 10 ml of 2% lignocaine hydrochloride to control the straining during the surgical procedure

Ratajezak *et al*. (2007) studied effect of epinephrine on epidural, intrathecal and plasma pharmacokinetics of ropivacaine and bupivacaine in sheep on results concluded epinephrine decreased the clearance and distribution processes

involved in epidural disposition of ropivacaine and bupivacaine, leading to an increased uptake into the intrathecal space with an apparently more pronounced effect for bupivacaine.

Rayees and Shukla (2011) studied the clinic-physiological and hemato-biochemical changes on lumbosacral epidural administration of ropivacaine (0.6 mg/kg-5mg/kg) in goats. The onset of analgesia was faster in treatment II (1-26 minutes) as compared to treatment I (2-50 minutes).Duration of analgesia was longer in treatment II (180 minutes)as compared to treatment I(110 minutes). In treatment I the respiratory rate did not differ significantly ($p>0.05$).The values of respiration rate fluctuated non significantly between 20 to 45 minutes. In treatment 2 there was a significant ($p<0.5$) decrease in respiratory rate from the control value and reached to its minimum value at 120 minutes after epidural administration of drugs. In treatment I there was non significant ($p>0.05$) decrease in rectal temperature .In treatment II there was a significant ($p<0.05$) decrease in rectal temperature from 0 to 80 there after rise in temperature was noticed and the value reached to pre treatment value at 480 minute. Among haematological parameters (Hb, PCV, TLC and DLC), Hb and PCV showed significant ($p<0.05$) decrease in treatment II while as other value remained unchanged while as in treatment I there was no alteration in these values during the study period.

Richard *et al*. (1988) compared pharmacokinetics of bupivacaine and ropivacaine in dogs after epidural and intravenous administration. The results indicated that after intravenous infusion of bupivacaine and ropivacaine, concentrations of ropivacaine decreased more rapidly than bupivacaine during elimination phase suggesting greater margin of safety.

Singh *et al.* (2005) evaluated anaesthetic effect of ropivacaine (0.6 mg/kg) by clinico-physiological and haemato-biochemical parameters in the uraemic (n=6) and healthy goats (n=6) after its lumbosacral epidural administration. Results indicated onset of analgesia was faster with complete and longer duration of analgesia- was observed healthy goats than uraemic goats. Changes in clinico-physiological and haemato-biochemical parameters in uraemic goats were

minimal, transient and became normal as the effect of the drug got over. Therefore, ropivacaine (0.6 mg/kg) might be used in clinical situations in uraemic caprines and in the animals, which are under similar type of physiological stress.

Singh *et al.* (2015) compared evaluation of ropivacine, (Group A ) bupivacaine (Group B) and xyalzine and ketamine (Group C ) combination for epidural analgesia in goats. They concluded that time of analgesia in animals in group A Group B and Group C was 20-40 ± 7.00 second, 17-41 ± 9.00 second and 23-31 ± 5.00 second, respectively. The time of analgesia did not differ significantly ($p < 0.05$) among these groups .In Group B and C significantly higher analgesia of the tail was recorded at 30,45,60,75,90,105 and 120 minutes intervals as compared to group A. The tail analgesia of group C was significantly higher at the 105 minutes interval than B. Perineal analgesia of group B and C was significantly($p<0.05$) higher than A after 30 minutes of observation .The duration of analgesia in animal groups A B and C was recorded as 71.5±14.40 minutes respectively .The duration of analgesia was significantly ($p<0.05$) shorter in group A as compared to B and C. Recovery time was significantly ($p<0.05$) shorter in group A as compared to B and C .Recovery time faster with ropivacaine followed by bupivacaine and the xylazine and ketamine combination .In group A heart rate decreased .In group B after a no significant ($p>0.05$) increase upto 15 minutes. A significantly lower respiratory rate from base value observed in group C at the 15 minutes interval.

Simon *et al*. (2002) conducted study on the effects of age on neural blockade and hemodynamic changes after epidural administration of ropivacaine 1.0% in patients undergoing orthopedic ,urological,gynaecological and lower

abdominal surgery.They concluded that age influenced the clinical profile of ropivacaine 1.0%

Writer *et al.* (1998) conducted study on neonatal outcome and mode of delivery after epidural analgesia for labour with ropivacaine and bupivacaine .They showed that spontaneous vaginal deliveries occurred more frequently overall with ropivacaine than with bupivacaine and instrumental deliveries less frequently while the frequency of caesarean section was similar between .groups.

Zuhair (2016) reviewed different epidural analgesia in cattle, buffalo and camels. It further concluded that ropivacaine, a long acting amino-amine local anaesthetic agent could be used (0.75%, 0.11mg/kg) for epidural analgesia in adult cows and concluded that ropivacaine resulted in prolonged bilateral perineal analgesia with minimal ataxia and cardiopulmonary effects in standing cattle.

# Chapter 3

# MATERIALS AND METHODS

The study on efficacy of two local anaesthetics viz., lignocaine hydrochloride and ropivacaine hydrochloride for epidural anaesthesia was conducted on 16 clinical cases of buffaloes. The buffaloes with various disorders like tail gangrene, vulval myiasis, vaginal tumor, vaginal polyps and prolapse of rectum, vagina, cervix and uterus were selected for the study. The animals were randomly divided into two groups with eight animals in each group. Drugs were administered epidurally at first inter-coccygeal space in animals of both the groups. Drugs and their dosage used for epidural analgesia in both the groups are presented in table (1).Two different techniques, epidural anaesthesia viz. Technique A(Traditional Technique in ten cases ) and Technique B(Epidural Anaesthesia by catheterization in six cases) were used, to achieve perfection,(Table 1).All the animals were subjected to requisite treatment surgery maneuver as per their affection of medicinal supportive therapy was provided. They were closed observed for complete recovery from epidural anaesthesia usually 12 to 18 hours further monitored until the clinical recovery from the disorder for about 7-8 days and followed up usually for 45 days after epidural anaesthesia for any event.

## 3.1 PILOT WORK

Before the commencement of project apart from Group I and II total 16 animals. Injection of ropivacaine hydrochloride was used for epidural anaesthesia at intercoccygeal space as below

a) At the dose rate of 0.2mg/kg body weight in two animal.
b) At the dose rate of 0.3mg/kg body weight in one animal.
c) At the rate of 0.5mg/kg body weight in two animal.

From this pilot work that was found that the dose rate of 0.3mg/kg body weight of ropivacaine hydrochloride was found suitable produced epidural

anaesthesia along with maintaining the standing posture in buffalo. Hence this was used for Group II.

Table 3.1: Design of technical programe of clinical study

| Sr. no | Group as per drug | Sub group as per techniqu e | Case/ Identity no of buffalo | Site of epidural anaesthes ia | Drug and dose (per kg body wt.) | Technique of epidural anaesthesia |
|---|---|---|---|---|---|---|
| 1 | I | A | 1, 2, 4, 6, 8 | First inter coccygeal space | Lignocaine HCl 2% @ of 0.3 mg | Traditional technique A |
| 2 | | B | 3, 5, 7, | | | Epidural injection with catheterization Technique B |
| 3 | II | A | 9, 10, 11, 12, 16 | First inter coccygeal space | Ropivacain e HCl 0.75% @ 0.3 mg | Traditional technique A |
| 4 | | B | 13, 14, 15 | | | Epidural injection with catheterization Technique B |

1) LOX-I: 2%, 30 ml vial (Each ml contains Lignocaine Hydrochloride I.P. 21.3 mg) Neon Pharma, Mumbai , India

2) ROPIN-II: 0.75%, 20 ml vial ( Each ml contains Ropivacaine Hydrochloride usp 7.5mg) Neon Pharma, Mumbai, India

3.2 Design of the project :

After the pilot work the present study was conducted in 16 clinical cases of buffaloes, requiring epidural anaesthesia for their treatment.Two different agents as lignocaine hydrochloride and ropivacaine hydrochloride were studied for their ethics and two different techniques were assessed to derive perfection and find their

utility in this project. A epidural anaesthesia kit comprising of the instrument and accessories was prepared.

3.2.1 Drugs used for epidural anaesthesia (Plate 1 and 2)

Group I. Lignocaine hydrochloride:

This group consisted of eight clinical cases (no 1 to 8) of buffaloes. These animals were subjected to intercoccygeal epidural anaesthesia using lignocaine hydrochloride. The lignocaine hydrochloride was used @ 0.3 mg/kg body weight.(Table no 1)

Group II. Ropivacaine hydrochloride:

This group consisted of eight clinical cases (no.9 to16) of buffaloes. These animals were subjected to intercoccygeal epidural anaesthesia using ropivacaine hydrochloride. The ropivacaine hydrochloride was used @ 0.3 mg/kg body weight.

3.2.2 Technique used for epidural anaesthesia subgroup A Subgroup B

Subgroup A: consisted of (case no.1,2,4,6,8) where in the technique A was used

Subgroup B: consisted of (case no.3, 5, 7, 13, 14, 15) where in the technique B was used.

Technique A. Traditional technique (Lumb and Jones)

The animal and the site was prepared following standard protocols and aseptic measures. By grasping the tail and moving it like a pump handle, the first intercoccygeal space was located. The needle was then introduced through either site at 45˚angle into the epidural space. One could feel the needle pierce the intervertebral ligament of the vertebrae just before it entered the epidural space.Alternatively,the hub of the needle was filled with local anaesthetic agent.After the needle entered into the epidural space the fluid would be aspirated from the needle hub when desired a test injection of 3.5ml of air was made to help confirm correct needle placement.No resistance to injection was noted when the anaesthetic agent was injected,and it could not be possible to withdraw blood from the epidural space. If resistance to injection was noted or blood was aspirated, the needle was redirected to the epidural space.The anaesthetic drug was administered as per the dose,and the requirement of the surgical treatment.

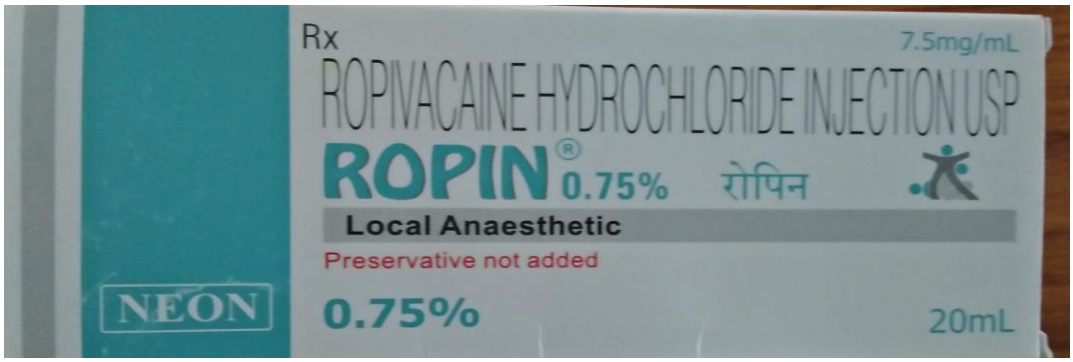



**PLATE 1A**

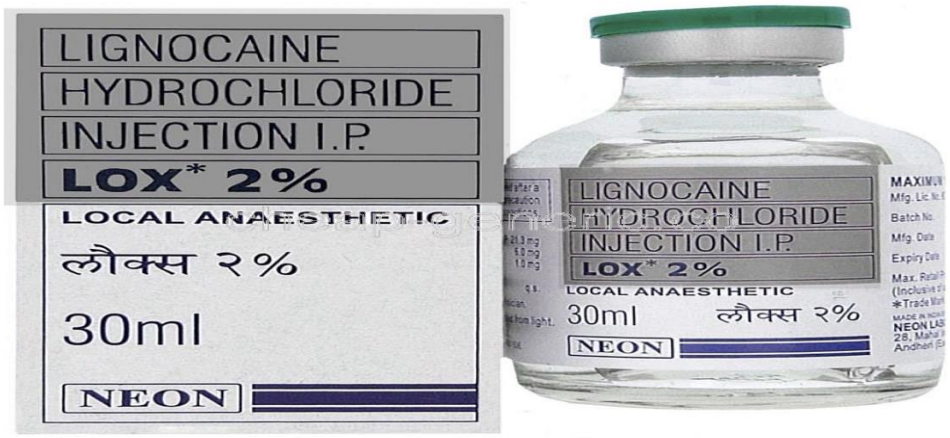



**PLATE 1B**

**Plate 1:A. Market pack of Inj. Ropivacine HCl**
**B. Market pack of Inj. Lignocaine HCl**

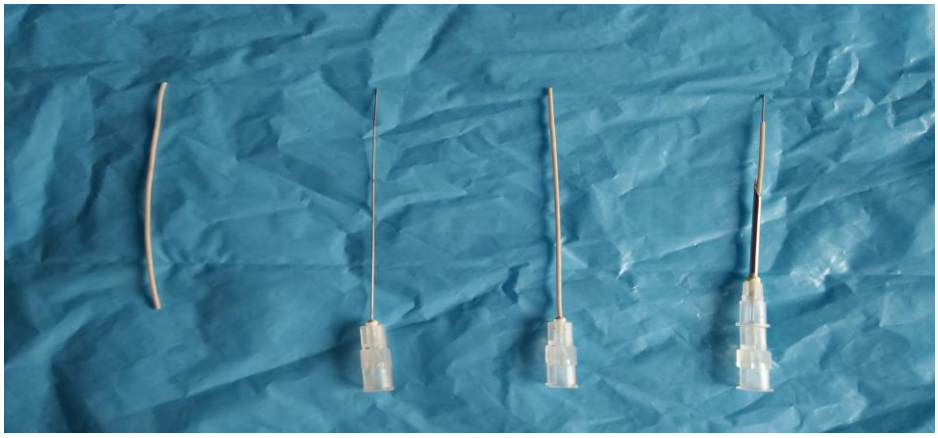


**Plate 2: Kit for Tech.B (Catheter, 18G spinal needle of 6 inch long, Placed spinal needle in catheter.**

Technique B. Epidural injection with catheterization:

The animal and the site was prepared following the standard methods and aseptic procedures.This technique was the suitable modification of the traditional technique A ().After the administration of spinal needle through the intervertebral space (IVS/) at the I and II intercoccygeal space, this technique was slightly differed.The procedure to reach the needle tip in epidural space was same as technique A. Once the tip of needle was reached to the epidural space and no further resisitance was felt it was stopped for advancing through the spinal canal or epidural space.One half to one ml of analgesic agent was administered to prevent any pain/jerk. Here a catheter of 0.08 mm was introduced through the preplaced spinal needle (18G, 6 inch long). Obviously it passed through IVF in the shaft of metal needle and the tip reached in spinal canal. A slight thrumble or jerk stimulation was shown by the animal as in response to the touch of catheter tip to meninges of cauda equina.

Further the catheter was gently advanced in the epidural space for 1 to 1.5 inch, where upon the feeling was either or all the below description. No resistance to catheter to the operator, free flow of CSF in retrograde manner to outside the catheter and air could be administered without any resistance, pushing CSF back in epidural space for about 2-3 ml. when this confirmation of placing catheter in the epidural or spinal canal was achieved. The drugs 1 and 2 were administered respectively in the animal 4,5 and 6 of the both groups of I and II.The spinal needle and cathetors were retained in place with adhesive tape,until complete procedure of medicosurgicaltreatment. That included removal of urine by catheterization of urinary bladder,per rectal pervaginal,examination reposition of prolapsed genitalia, intra uterine medication and so on.

Preparation of the kit for epidural anaesthesia with technique A and Technique B:

Kit for Technique A: Spinal needles 18 and 16 G,nylon syringes of 10 ml, dettol as detergent,betadine scrub and antiseptic lotion,spirit for dressing Gauze pieces

,stillates for the needles,hand glove and,obstetric hand gloves,travis,rope,vaginal speculum urinary catheter, casting bed,uterine catheter as accessory items.

Kit for Technique B(Epidural catheterization):All the above materials instruments as for technique A.In addition fine cathetors or rubber wire of 0.08 to 0.1mm diameters and18 to 20 cm long,surgical adhesive tape,dressing scissors,stylates for the needles and cathetors.Sterile disposable drape or sheet,nylon, syringes,10ml/20ml ,hypodermic needle.

Emergency medications:The routine emergency medicinal kit including injection atropine sulphate 30ml ,inj.chlorpheneramine maleate 30ml.inj.meloxicam 30ml,inj.dexamethasone10ml ,inj.stadren 30ml,inj. Methargin.Suitable hypodermic needles,syringes and syringes and i/v infusion sets.These medications were kept as a stand by for use, in case of any untoward reaction or event.

## 3.3 Clinical Observation:

### 3.3.1 Duration of Induction:

Time of induction was recorded from injection of epidural anesthesia to loss of sensation in perineal region. The buffaloes response to pinpricks with a 24 G, 2.5 cm hypodermic needle was recorded at the perineal region on either side of the midline approximately 4 to 5 cm below the anus.This was noted after 4 minutes and then at at one minute intervals, each time two or three pricks were made and the needle was inserted approximately 2 cm. A strong avoidance response, manifested in kicking, rapid shifting of weight on the hind limbs, rapid movement of the tail and turning of the head towards the site of the pinpricks was considered the normal response of the animal to the stimulus. The time from the epidural injection to the observation of a diminished avoidance response (analgesia score of 1 or more) was recorded as the time of onset of analgesia.

Assessment of Analgesia score

| Grade | Observation |
|---|---|
| 1 | Unnoticed |
| 2 | Short |
| 3 | Moderate |
| 4 | Long |

3.3.2 Duration of maintenance of anesthesia:

Time of duration of maintenance ofanesthesia was recorded from moderate /complete diminished response to the needle pricks around anus and base of tail till the complete recovery from anesthesia.

| Grade | Observations |
|---|---|
| 1 | Unnoticed |
| 2 | Mild |
| 3 | Moderate |
| 4 | More |

3.3.3 Duration of recovery:

The recovery period was noted after the last incremental dose, when first sign of motor or sensory reflex such as any slight sphincter,vulval/any voiding of

urine micturition or defeacation attempt, slight sensation after pricking,increased tone in anesthetized area till the complete gain in the sensation, tone of muscle, normal posture i.e. walking without incoordination was the duration recovery .

| Grade | Observations |
|---|---|
| 1 | Smooth |
| 2 | Struggling |
| 3 | Violent |

3.3.4 Motor incoordination/ataxia

Motor incoordination was evaluated at the same time intervals and similarly graded on a scale from 0 to 3: 0 Walking without staggering; 1 Able to stand and walk with little incoordination; 2 Frequent swaying of body but able to stand and walk with extreme incoordination; 3 Unable to stand

The mean scores for analgesia and ataxia of the groups at each time were classified as either very mild, mild, moderate or complete; a mean score of less than 1 was considered as very mild, a score of 1 or more but less than 2 as mild, of 2 or more but less than 3 as moderate, and 3 as complete.

Grading of Motor Incoordination

| Grade | Observations |
|---|---|
| 1 | Nil |
| 2 | Mild |
| 3 | Moderate |
| 4 | More |

3.3.5 Clinical observations regarding epidural anaesthesia (Qualitative parameters) of both groups

1. Organs and area
2. Abolition of pain
3. Quality / depth of anaesthesia
4. Straining
5. Ataxia / motor incoordination
6. Weight bearing
7. Any anxiety expressed by looking back or moving the rump, steping back forth, avoiding/cooperating to the perianal maneuvers etc.
8. Observations on induction and recovery

3.5 Clinical observations regarding surgery, under epidural anaesthesia of both groups:

a) Relaxation of tone / structure under observation / handling
b) Hemorrhage / bleeding
c) Any resistance / jerky movements / hyperesthesia / while pulling / handling the structure
d) Repeated dose required
e) Average duration of surgery for similar type of operation
f) Overall good depth and duration of analgesia to limited or more area
g) Behavior of animal to the overall procedures of anaesthesia and surgery
h) Attempts of straining, defecation, urination, raising/moving tail
i) Face expressions as retracting cheeks/lips, protruding of tongue, mouth commissures, opening of jaw breathing pattern ,salivation and anxious look, tolerance, any stress so on.

### 3.6 Quality of Epidural analgesia:

| Grade | Observation |
|---|---|
| 1 | Mild |
| 2 | Optimum |
| 3 | Satisfactory |
| 4 | Good |

### 3.7 Physiological Observations

3.7.1. Heart Rate (beats/minute):

The heart rate was measured by auscultation using a stethoscope at 0, 15,30, 60 and 120 minutes after injection of anaesthetic solution.

3.7.2. Respiratory Rate (breaths/minute):

The respiratory rate was measured by observing the movement of thoracic and abdominal wall during inspiration and expiration at 0, 15,30, 60 and120 minutes after injection of anaesthetic solution.

3.7.3. Rectal temperature ($^0$F):

The rectal temperature was recorded by placing clinical thermometer into the rectum of the animal at 0, 15,30, 60 and 120minutes after injection of anaesthetic solution.

### 3.8. Haematological observations:

The blood samples (2 ml) were collected in EDTA containing vials before and at interval of 120 min after injection of drugs for estimation of following parameters as per the standard method.

3.8.1 Haemoglobin (g/dL):

Haemoglobin was estimated by Sahli's haemoglobinometer as per the standard method recommended by Schalm *et al*. (1975) and the values obtained were expressed as g/dL.

3.8.2 Packed cell volume (%):

The packed cell volume was determined by the microhaematocrit method using microcentrifuge at the speed of 10,000 rpm for 5 minutes. The values were expressed in percentage.

3.8.3 Total leukocyte count (thousand cells /µL):

Total leukocyte count was estimated as per the procedure described by Jain(2000) and the values were expressed as thousand cells per micro liter of blood (x $10^3$/µl).

3.8.4 Differential Leukocyte Count:

Blood smears for differential leukocyte count were stained withGiemsa stain and cells were counted using Battlement method as described by Jain (2000) and the individual cells were expressed in percentage.

## 3.9 Observationsregarding surgical interventions

To demonstrate an adequate level of surgical anaesthesia and efficacy of a particular anaesthetic agent for surgical procedure, animals were subjected to surgical interventions according to clinical case. In all the groups, the approximate time from administration to initiation of surgery was 20 minutes. Standard aseptic precautions and surgical techniques were followed.

Table 3.2:Group wise surgical intervention

| Sr. No. | Nature of surgical condition | Group I |
|---|---|---|
| 1 | Tail Gangrene | 1 |
| 2 | Traumatic wound on tail | 1 |
| 3 | Prolapse of Uterus | 1 |
| 4 | Prolapse of Uterus | 1 |
| 5 | Caesarean section | 1 |
| 6 | Caesarean section | 1 |
| 7 | Vaginal tear | 1 |
| 8 | Vaginal tear | 1 |
| | | Group II |
| 9 | Tail gangrene | 1 |
| 10 | Tail crushing wound | 1 |
| 11 | Prolapse of Uterus | 1 |
| 12 | Prolapse of Uterus | 1 |
| 13 | Caesarean section | 1 |
| 14 | Caesarean section | 1 |
| 15 | Vaginal tear | 1 |
| 16 | Vaginal tear | 1 |

3.10 Merits of the Techniques A and B for epidural anaesthesia:

3.11 Statistical analysis:

Data obtained in the present study was analyzed by Student ‘t’ test to compare the data within and between the groups as described by Snedecor and Cochran (1994).

# Chapter 4

# RESULTS AND DISCUSSION

The present study was conducted on 16 clinical cases of buffaloes brought at TVCC and Department of Surgery and Radiology, College of Veterinary and Animal Sciences, Udgir, with various disorders like tail gangrene, vaginal tumor, vulval myiasis, and prolapse of rectum, vagina, cervix and uterus, metritis and dystokia were selected for the study. . The animals were randomly divided into two groups with eight animals in each group. In group I 2% lignocaine hydrochloride and in group II 0.75% ropivacaine hydrochloride were injected epidurally. Epidural anaesthesia involved injection of local anaesthetic and/or other appropriate drugs into the epidural space at the first intercoccygeal junction in order to produce analgesia of the tail, perineum, genitalia and pelvic viscera,and to acquire tolerance by the buffaloe to the medicosurgical procedures.Two different techniques for epidural anaesthesia viz. Technique A (Traditional Technique ) in ten cases and Technique B(Epidural anaesthesia by catheterization) in six were used.

Detail observations regarding analgesia, anesthesia, recovery after anesthesia were recorded. Moreover physiological, hematological and clinical observations in buffaloes were recorded before, during and after complete recovery from anesthesia.

Overall the case of buffalo was closely observed for 3to7 days and followed up until 45 days after the procedure of epidural anaesthesia and treatment. All the cases of both the groups survived and made the recovery and not any major disability or untoward event was noticed, during period of observation.

## 4.1 Pilot Work for Ropivacaine

Injection lignocaine is most frequently used for epidural anaesthesia in large animal practice and is well documented.

Injection ropivacaine was comparatively a new drug that was evaluated for efficacy in this research.There was no much experience with the dose and use of inj.ropivacaine HCl for epidural anaesthesia by the present researchers. The intention was to achive epidural anaesthesia for the treatment measures in the affected

buffaloes, without straining/discomfort and preferably in standing position well, for lengthy procedures or specific manouvers maintenance of standing procedure was not desired such as in cases for of caesarean section operation and correction of torsion at preparturation.

The pilot work showed that caudal epidural anaesthesia could be produced with the help of inj,ropivacaine hydrochloride (0.75%) at the dose rate of 0.3 mg/kg body wt. for some duration while the animals maintained the standing posture.Considering the safe and satisfactory utility of this drug, this dose rate was used in the present project. The scanty literature on the use of this drug in cattle also affirmed the use of inj. Ropivacaine in similardose (Singh and Gapsiso , 2007)

### 4.2 Design of work

Lignocaine hydrochloride has been used on large scale for epidural anaesthesia in cattle and buffalo and supposed to be the standard drug for this purpose.Hence it was included for comparative assessment.

However,in the attempt of prompt and prolong epidural anaesthesia,it was observed that,animals showed hindlimb incoordination and unability to maintain standing posture.Aiso it required repeated/incremental administration of the drug.Therefore it was used for comparative assessment and therby finding the efficacy of the newer drug ie.inj ropivacaine hydrochlorid,under the present research project.

Secondly, epidural anaesthesia in affected large animals is a skillful procedure, demanding prompt /exact administration of the drugs in the epidural space, with minimum trauma to both soft tissues on rump and especially the meninges in the spinal canal. It is of paramount importance that the whole procedure need to be achieved without any or negligible infection to the vital structures. This is in spite the fact that the animal moves alters her posture and resists being administered epidurally. So also while the incremental dosage are required to complete task.

In the events to achieve these goals in human being and certain animals sophisticated techniques are being evolved. In this attempt the present study included the evaluation of modified technique B, over the technique A with the use of very economic catheter for the procedure, following the aseptic measures thought.

**Table 4.1 Clinical observation regarding epidural anesthesia in Group I (Lignocaine HCl )**

| Sr. No. | Serial number of case | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Type of affection or disease | Tail Gangrene | Traumatic wound on tail | Prolapse of uterus | Prolapse of uterus | Caesarean Section | Caesarean Section | Vaginal Tear | Vaginal Tear |
| 2 | Type of maneuver or surgical treatment | Amputation of tail was done | Amputation of tail was done | Manured repositioning of prolapsed mass and suturing the tear | Cleaning and repositioning of prolapsed mass and fixing with rope truss | Caesarian operation was done | Caesarian operation was done | Repair with suturing and repositioning | Repair with suturing and repositioning |
| 3 | Characters of observations Organs and Area desensitization | Tail, anal and pereneal region | uterus, bladder, rectum, vagina and vulva and Perineal region | uterus, bladder, rectum, vagina and vulva and Perineal region | uterus, bladder, rectum, vagina and vulva and Perineal region | Peritoneum, Uterus, vagina and vulva and lower abdominal cavity | Peritoneum, Uterus, vagina and vulva and lower abdominal cavity | uterus, bladder, rectum, vagina and vulva and Perineal region | uterus, bladder, rectum, vagina and vulva and Perineal region |
| 4 | Abolition of pain | No sensation | Mild sensation | Mild sensation | Mild sensation | Mild sensation | Mild sensation | No sensation | No sensation |
| 5 | Quality /Depth of Anesthesia | Mild | Optimum | Optimum | Optimum | Satisfactory | Satisfactory | satisfactory | Good |
| 6 | Straining | Mild | Severe | Severe | Severe | Moderate | Moderate | Severe | Severe |
| 7 | Ataxia/Motor in coordination | Moderate | Severe | Severe | Severe | Severe | Severe | Moderate | Moderate |
| 8 | Weight Bearing | Sound | Reluctant to stand | Reluctant to stand | Reluctant to stand | Recumbent | Recumbent | Sound | Half crunching in hand legs |
| 9 | Observation on Induction & Recovery | Smooth | Smooth | Slightly uneven | Slightly uneven | Slightly uneven | Struggling | Struggling | Violent |
| 10 | Technique of epidural anaesthesia | Tech. A | Tech. A | Tech. B | Tech. A | Tech. B | Tech. A | Tech. B | Tech. A |

**Table 4.2 Clinical observations regarding surgery in Group I**

| Observations | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 | Case 8 |
|---|---|---|---|---|---|---|---|---|
| a) Relaxation of tone/ structure under observation/ handling | Tail Rectum, vagina and vulva relaxed | Tail, Rectum, vagina and vulva relaxed | Uterus, bladder, tonic rectum, vagina andvulva | Uterus, bladder, tonic rectum, vagina and vulva | Peritoneum , Uterus, vagina and vulva relaxed | Peritoneum , Uterus, vagina and vulva relaxed | uterus, bladder, rectum, vagina and vulva | uterus, bladder, rectum, vagina and vulva |
| b) Hemorrhage/Bleeding | No | Less | Less | Less | More | More | Less | Less |
| c) Any Resistance/Jerky movements | No | Moderate | Moderate | Moderate | Mild | Mild | Mild | No |
| d) Repeated administration of dose required | Incremental dose required | Incremental dose required | Incremental dose not required | Incremental dose not required | Incremental dose Required | Incremental dose Required | Once Incremental dose required | Incremental dose required |
| e) Duration of surgery (minutes) | 30-40 | 35-45 | 35-45 | 35-45 | 180-210 | 180-210 | 35-40 | 35-40 |
| f) Behavior of animal to the surgery procedures | Mild resistance | Uneasiness | Uneasiness | Uneasiness | Mild resistance | Mild resistance | Attempt to move away | Attempt to move away |

General and gross remark :- Overall experience or feeling was the cases shown calm behavior occasional restlessness or resistance during incision or suture, cautious behavior and uneasiness noted from attempting move, look on back side. This was suggestive of mild pain.

**Table 4.3 Clinical observations regarding epidural anesthesia in Group II (Ropivacaine HCl)**

| **Group II** | **Case 9** | **Case 10** | **Case 11** | **Case 12** | **Case 13** | **Case 14** | **Case 15** | **Case 16** |
|---|---|---|---|---|---|---|---|---|
| **Ropivacaine HCL (0.3mg/kg BW)** | **Tail Gangrene** | **Tail crushing wound** | **Prolapse of uterus** | **Prolapse of uterus** | **Caesarean Section** | **Caesarean Section** | **Prolapse with Vaginal Tear** | **Prolapse with Vaginal Tear** |
| Organs & Area Showing | Tail rectum, vagina and vulva and Perineal region | Tail rectum, vagina and vulva and Perineal region | uterus, bladder, rectum, vagina and vulva and Perineal region | uterus, bladder, rectum, vagina and vulva and Perineal region | Peritoneum, Uterus, vagina and vulva and lower abdominal cavity | Peritoneum, Uterus, vagina and vulva and lower abdominal cavity | uterus, bladder, rectum, vagina and vulva and Perineal region | uterus, bladder, rectum, vagina and vulva and Perineal region |
| Abolition of pain | No sensation | Mild sensation | No sensation | Mild sensation | No sensation | No sensation | No sensation | No sensation |
| Quality /Depth of Anesthesia | Good | Good | Optimum | Optimum | Satisfactory | Satisfactory | Good | Good |
| Straining | Mild | Moderate | Moderate | Moderate | Mild | Mild | Mild | Mild |
| Ataxia/Motor in coordination | Mild | Moderate | Moderate | Moderate | Mild | Mild | Mild | Mild |
| Weight Bearing | Sound | Sound | Sound | Sound | Recumbent | Recumbent | Sound | Sound |
| Observation on Induction & Recovery | Smooth | Smooth | Smooth | Smooth | Slightly uneven | Slightly uneven | Violent | Smooth |
| Technique of epidural anaesthesia | Tech. A | Tech. A | Tech. A | Tech. A | Tech. B | Tech. B | Tech. B | Tech. A |

**Table 4.4 Clinical observations regarding surgery in Group II**

| **Observations on Surgery** | **Case 9** | **Case 10** | **Case 11** | **Case 12** | **Case 13** | **Case 14** | **Case 15** | **Case 16** |
|---|---|---|---|---|---|---|---|---|
| a) Relaxation of tone/ structure under observation/ handling | Tail | uterus, bladder, rectum, vagina and vulva | uterus, bladder, rectum, vagina and vulva | uterus, bladder, rectum, vagina and vulva | Peritoneum, Uterus, vagina and vulva | Peritoneum, Uterus, vagina and vulva | uterus, bladder, rectum, vagina and vulva | uterus, bladder, rectum, vagina and vulva |
| b)Hemorrhage/Bleeding | No | Less | Less | Less | Less | Less | No | No |
| c) AnyResistance/Jerky movements | No | Mild | Mild | Mild | No | No | No | No |
| d)Repeated administration of dose required | Incremental dose not required | Incremental dose not required | Incremental dose not required | Incremental dose not required | Incremental dose required | Incremental dose required | Incremental dose not required | Incremental dose once required |
| e) Duration of surgery (minutes) | 25-30 | 30-40 | 30-40 | 30-40 | 160-180 | 160-180 | 35-40 | 35-40 |
| f) Behavior of animal to the surgery procedures | Mild resistance | Mild resistance | Mild resistance | No resistance | No resistance | No resistance | No resistance | No resistance |

General and gross remark :- Overall experience or feeling was the cases shown calm behavior occasional restlessness or resistance during incision or suture, cautious behavior and uneasiness noted from attempting move, look on back side. This was suggestive of mild pain.

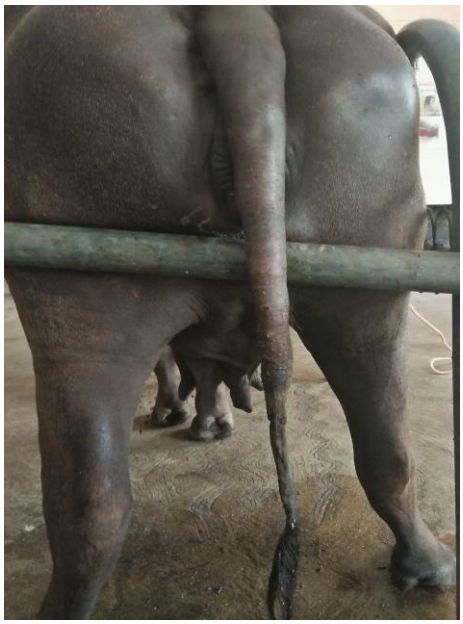


PLATE 3A

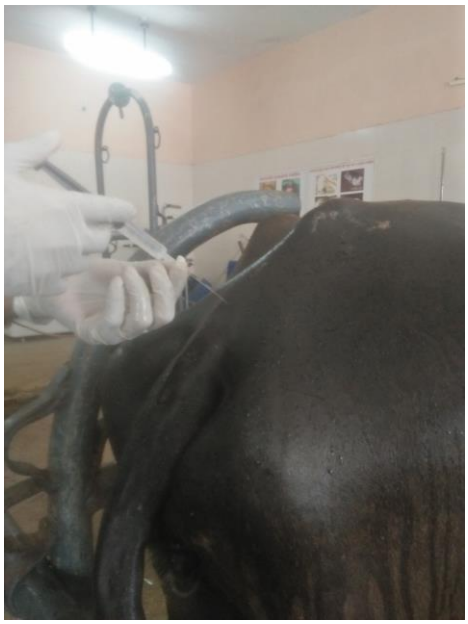


PLATE 3B

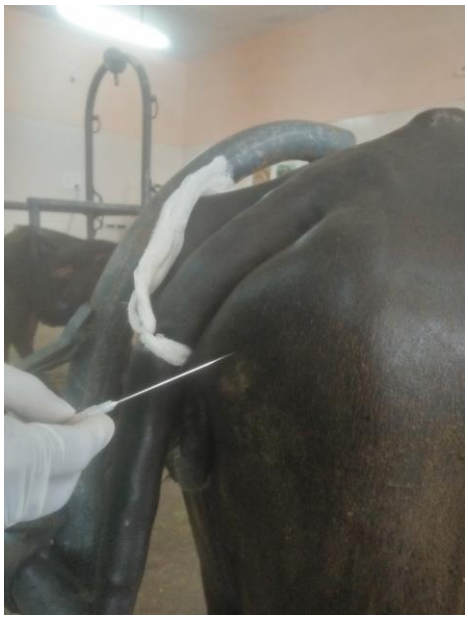


PLATE 3C

PLATE 3D

**Plate 3:A. Case no.1 tail gangrene**
**B. Epidural anaesthesia with Tech. A**
**C. Checking induction**
**D. After amputation of tail**

PLATE 4A

PLATE 4B

PLATE 4C

**Plate 4: A. Case no. 4 Severe uterovaginal prolapse**
**B. Administration of lignocaine HCl with Tech.A**
**C. Reposition of genitalia using rope truss**

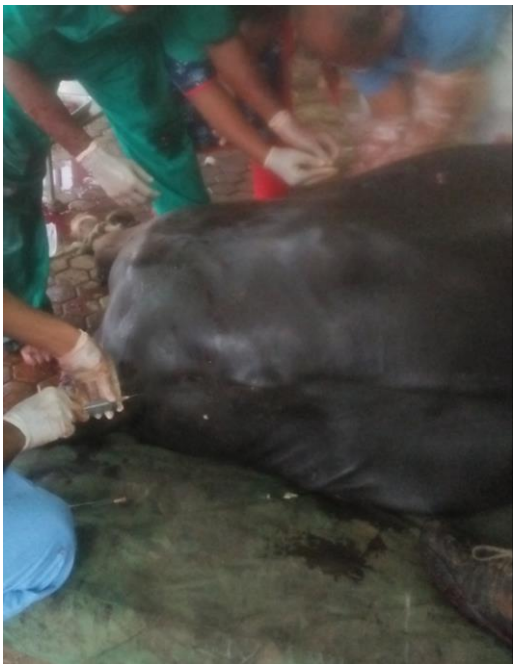


**PLATE 5A**

**PLATE 5B**

**PLATE 5C**

**Plate 5: A. Case no.6 Cesarean operation under lignocaine HCl using Tech.A**
**B. Performing of operation under epidural anaesthesia**
**C. After completion of operation**

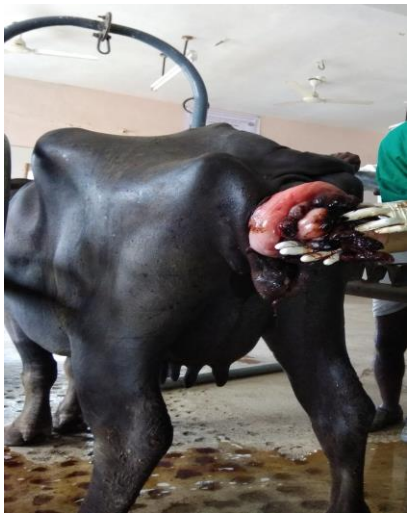


PLATE 6A

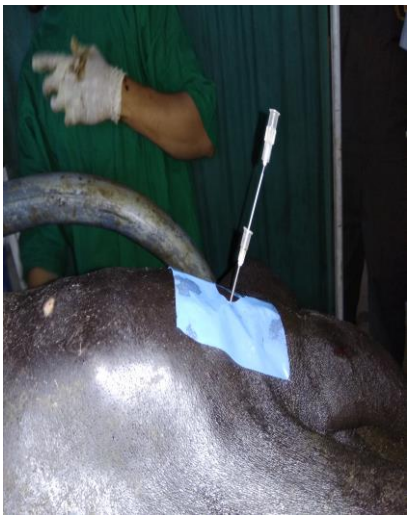


PLATE 6B

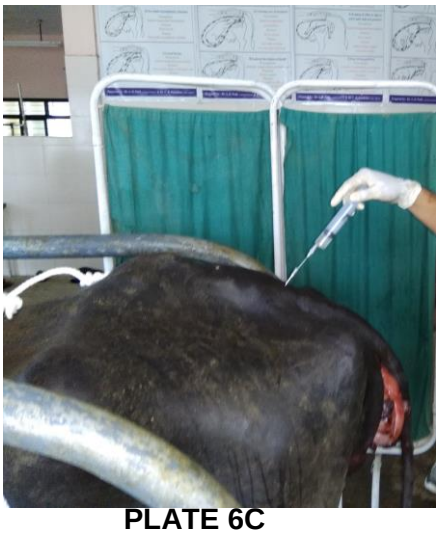


PLATE 6C

PLATE 6D

PLATE 6E

**Plate 6: A. Case no.7 severe genital prolapse and laceration**
**B. Placement of needle using Tech.B**
**C. Administration of lignocaine HCl**
**D. Anasethesia induced**
**E. Reposition and repair of genitalia**

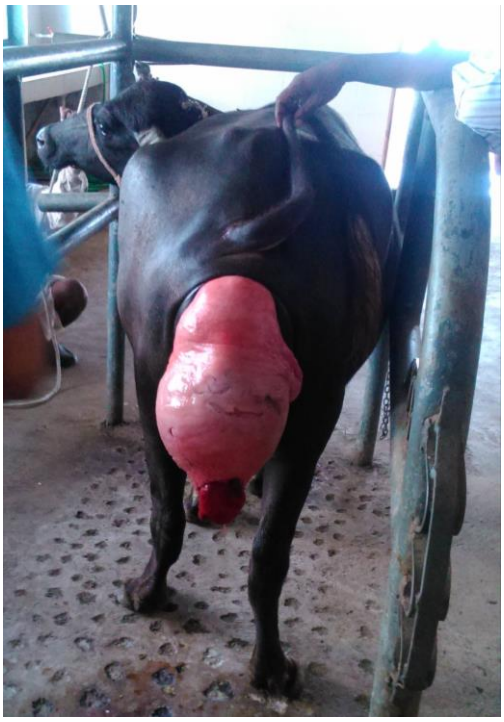


**PLATE 7A**

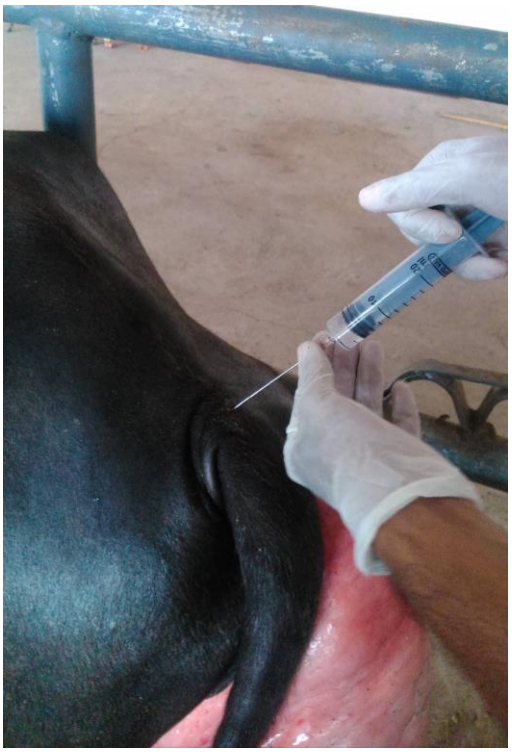


**PLATE 7B**

**Plate 7: A. Case no.9 Cervico-vaginal prolapse**
**B. Placement and administration of ropivacine HCl under Tech.A**

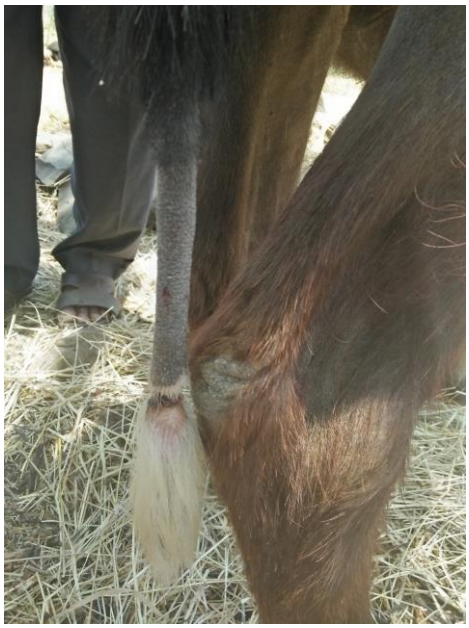


**PLATE 8A**

**PLATE 8B**

**PLATE 8C**

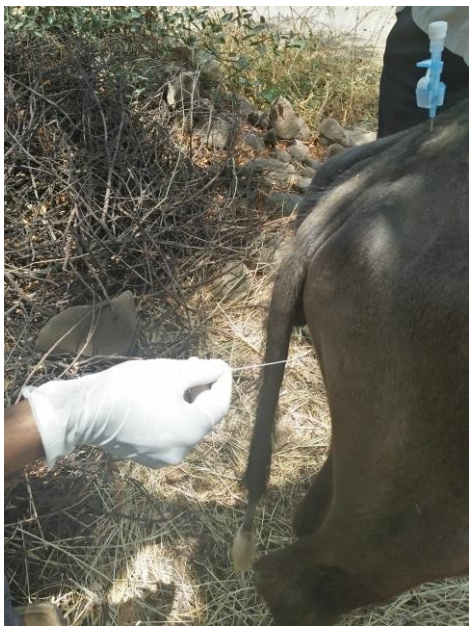


**PLATE 8D**

**Plate 8: A. Case no.10 crushing wound on tail**
**B. Placement of spinal needle and catheter (I/V canula) through it**
**C. Administration of ropivacaine HCl**
**D. Anaesthesia induced**

**PLATE 9A**

**PLATE 9B**

**PLATE 9C**

**PLATE 9D**

**Plate 9: A. Case no.15 prolapse with vaginal tear**
**B. Administration of ropivacaine HCl using Tech. B**
**C. Checking induction after administration**
**D. Reposition and repair of prolapsed mass and vaginal tear**

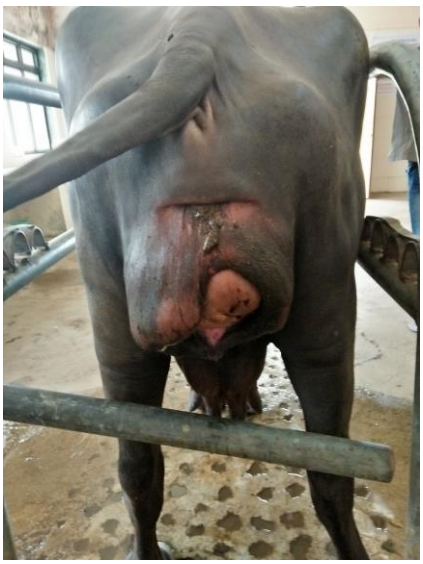


**PLATE 10A**

**PLATE 10B**

**PLATE 10C**

**Plate 10: A. Case no.16 prolapse with vaginal tear**
**B. Administration of ropivacaine HCl using Tech. A**
**C. Reposition and repair of vaginal tear**

### 4.3 Clinical observations regarding epidural anaesthesia:

Group I and Group II comprised of 8 cases of buffaloes each (No. 1-8 and 9-16 respectively) that were treated under epidural anaesthesia with lignocaine HCl and ropivacaine HCl at the dose rate of 0.3mg/kg B. Wt. the incremental dose was given as per need the types of cases and main form of treatment are shown in table 4.4-4.5 and 4.6-4.7 respectively. Technique A for epidural ananesthesia was used in Case No. 1,2,4,6 and 8 in group I and case No. 9,10,11,12 and 16 were as Technique B was used in case No. 3,5 and 7 in group I and case No. 13,14 and 15 in group II (Table 4.1 to 4.4)

#### 4.3.1 Duration of Induction

After epidural injection time required to abolish response to pin pricks provided duration induction of anesthesia. The mean ± SE induction time for group I and II were 5.20 ± 0.31 and 12.60 ± 0.37 minutes, respectively.

The duration of induction analgesia was significantly (P≤0.01) less with lignocaine hydrochloride than to ropivacaine hydrochloride (table 4.5 and fig. 1).

Similar findings were reported by Howel *et al*. (1990) with lignocaine and Araujo *et al*. (2012) with ropivacaine. This has been attributed to the fact that local anesthetics administered into the epidural space might diffuse through all the meningeal layers to reach the dorsal horn of the spinal cord to exert their effect (Johnson *et al*., 1996 and Muir and Hubbell, 1995). The viscocity of ropivacaine was more than lignocaine, so the dispersion in the tissue was slow and induction took longer period than that of lignocaine.

**Table 4.5 Mean ± SE of duration of induction in both the groups of local anaesthetics**

| PARAMETER | GROUP I | GROUP II |
|---|---|---|
| Duration of induction (minutes) | $5.20 \pm 0.31^{y}$ | $12.60 \pm 0.37^{x}$ |

x,y Means bearing superscript x, y differed significantly (P≤ 0.01) between groups at corresponding intervals.

### 4.3.2 Duration of maintenance (minutes)

Time from induction of anesthesia to complete recovery from anesthesia was calculated as duration of maintenance of anesthesia. The mean ± SE values of duration for maintenance analgesia for group I, and II were; 90.08 ± 2.93 minutes and 382.40 ± 4.82 minutes, respectively. The duration of analgesia was significantly (P< 0.01) longer in group II than group I animals (Table 4.6 and fig. 2).

Amarpal *et al*. (2007) observed recovery from analgesia after 6 to 7 hours and 8 to 9 hours after epidural administration of ropivacaine (0.75%) with 5 ml and 10 ml volume respectively in buffalo calves. In contrast, Singh *et al*. (2005) recorded shorter duration of analgesia in goats with ropivacaine compared to the results of this study. Hall and Clarke (1983) suggested that protein binding character of local anaesthetic agents influence the duration of action.

Ropivacaine is more effective as an epidural analgesia with pain relief for long duration analgesia (Hall *et al*., 2001) on the contrary lignocaine produced pain relief for 45 to 60 minutes and may be used for short term analgesia (Skarda, 1991).

**Table 4.6 Mean ± SE of duration of maintainance of analgesia in both the groups of local anaesthetics**

| PARAMETER | GROUP I | GROUP 1I |
|---|---|---|
| Duration of maintainance analgesia (minutes) | $90.08 \pm 2.93^{y}$ | $382.40 \pm 4.82^{x}$ |

x, y Means bearing superscript x, y differed significantly (P≤ 0.01) between groups at corresponding intervals.

### 4.3.3 Duration of recovery

Time required from injection of last anesthetic till complete recovery from anesthesia noted in both groups. Mean time required for complete recovery in 40.00+2.25 and 176.21+12.83.in group I and Group II respectively.

The time required for complete recovery of the animals from the anesthetic effect in group I 40.00 ± 2.35 minutes was significantly lower as compared to the time required for complete recovery in group II animals 176.21 ± 12.83 minutes (Table 4.7 and Figure 3).

These present finding for duration of recovery is in an agreement with the earlier report of Umar and Gapsiso (2008) who reported the time required for complete recovery to be 33.8 ± 30.4 minutes using lignocaine hydrochloride.

In the duration of recovery the present finding was more and hence not in agreement with the earlier report of Singh *et al* (2015a ) who reported the duration of recovery as 83.25 ± 16.9 minutes and 128.57 ± 58 minutes using ropivacaine and bupivacaine in buffalo calf respectively. Thus difference might be due to difference in the species of animals in caprines used for his experiment.

**Table 4.7 Mean ± SE time taken for recovery in both the groups of local anaesthetics**

| PARAMETER | GROUP I | GROUP II |
|---|---|---|
| Duration of Recovery (minutes) | $40.00 \pm 2.35^{y}$ | $176.21 \pm 12.83^{x}$ |

x, y Means bearing superscript x, y differ significantly (P≤ 0.01) between groups at corresponding interval.

### 4.3.4 Organ and area of desensitization:

The case no. 3 and 4 from group I and 9 and 10 from group II for amputation of tail did not require incremental dose of dug the tail, anus were satisfactorily desensitized using almost in all cases of the tail, anus, orifice, perineum, vulva, commissure, perineum nearly upto middle of thigh were anaesthetized. Incremental dose of lignocaine and ropivacine was required in 6 and 4 cases respectively (1,2,5,6,7 and 8 in group I and 13,14,15 and 16 in group II) for completion of surgery to maintain abolition of pain of the structure.

### 4.3.5 Abolition of pain:

Complete abolition of pain was observed in case No. 1,7 and 8 from group I and case No. 9,11,13,14,15 and 16 from group II. The remaining cases of group I and Group II experienced mild pain and sensation during treatment. The need of incremental dose for cesarean operation, prolapse reposition and repair of vaginal tear was experienced or necessitated by David *et al*. (2001).

Similarly Lumb and Jones (1984) have advised that to complete the amputation of tail satisfactorily without any pain requires incremental dose.

### 4.3.6 Quality of anaestehsia:

Quality of anaesthesia i.e. muscle relaxation, tone and analgesia was mild in case no. 1, optimum in case no. 2,3,4 and 11, 12, satisfactory in case no. 6,7 and 13,14 and good in case no. 8 and 9,10,15,16 in group I and II respectively.

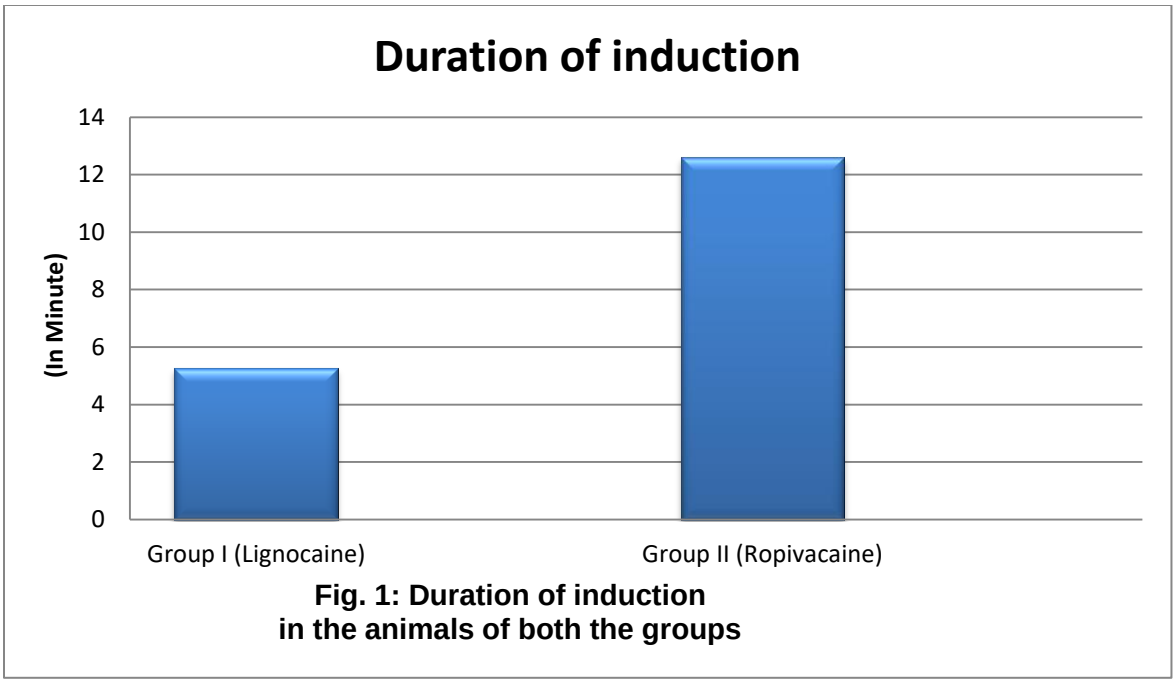



**Fig. 1: Duration of induction in the animals of both the groups**

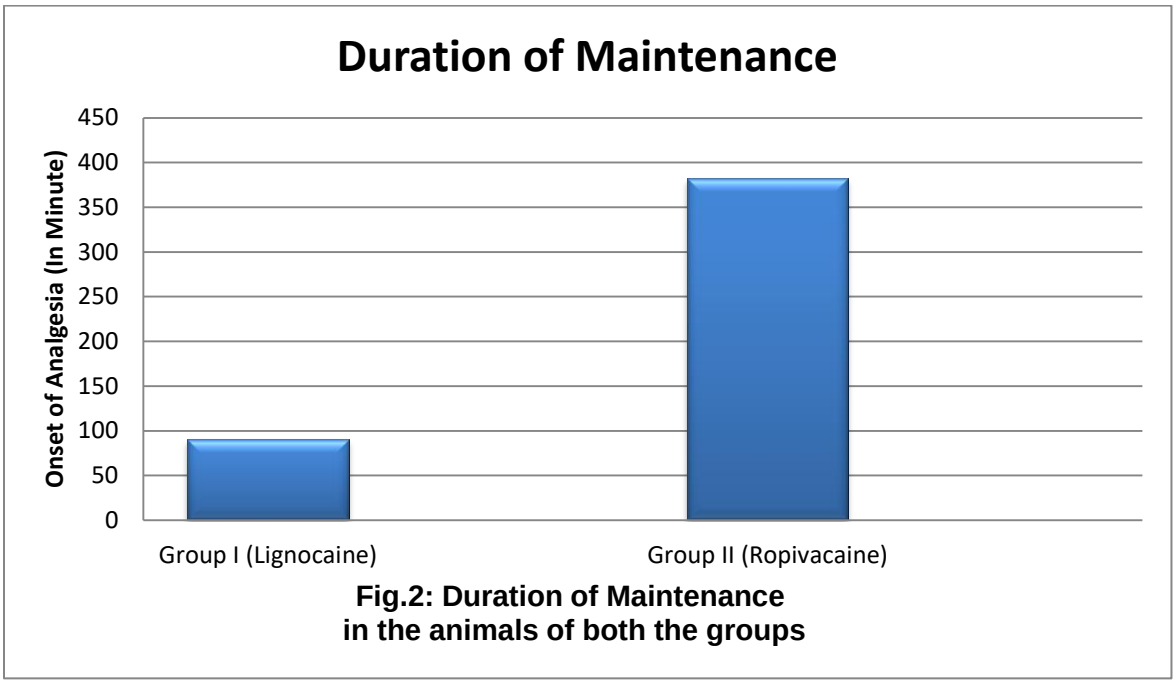



**Fig.2: Duration of Maintenance in the animals of both the groups**

### 4.3.7 Straining:

Straining was moderate in case no. 5 and 6 in group I and case no. 10,11 and 12 in group II, severe in case no. 2,3,4,7 and 8 in group I and no case in group II and mild in case no. 1 in group I and case no. 9,13,14,15 and 16 in group II.

From present observation it was observed that the complete straining, pelvic muscle relaxation and irritation of genitalia was not completely reduced with lignocaine HCl as compared to ropivacaine HCl.

### 4.3.8 Ataxia / motor incoordination:

Motor incoordination was moderate in case no. 1,7 and 8 from group I and case no. 10,11 and 12 from group II, severe in case no. 2,3,4,5 and 6 from group I and no case from group II and mild in case no. 9,13,14,15 and 16 from group II and no case from group I.

Weight bearing was correspondingly found diminished making the buffaloes reluctant to stand in case no. 2,3 and 4 and completely recumbent in case no. 5 and 6 and only case no. 1,7 and 8 were able to maintain standing with crunching in hind limbs with the useof lignocaine HCl in group I were as comparatively buffaloes of group II did not revealed motor incoordination, any more than mild or moderate and also the weight bearing not a problem in these. However case no. 14 and 15 of group II were casted to recumbent for performing cesarean operation.

Ropivacaine administered animals (group II) showed less ataxia than lignocaine administered animals of (group I). Similar finding were seen by Singh *et.al* (2005).Also similar results were observed by Skarda and Muir (2001) in mares which received 8 to 9 ml of 0.5% ropivacaine in sacrococcygeal space. In contrast, Amarpal *et al*. (2007) observed severe ataxia in buffaloes with 0.75% of ropivacaine.

In the present study, animals of group I (Lignocaine) showed significantly high degree of ataxia. Lignocaine indiscriminately blocks the sensory, sympathetic and motor fibers (Le Blance *et al*., 1988: Fikes *et al*., 1989 and Grubb *et al*., 1992).

### 4.3.9 Observations on induction and recovery:

As for the induction and recovery from the epidural anaestheisa was considered, it was with some struggling in case no. 6,7 and violent in case no. 8 which were anaesthetized for prolong period and smooth in 1,2,3,4 and 5 in group I. further it was with the events of anxiety, repeated attempts to get up and downs so on in cases no. 3,4 and 5 and smooth in 1 and 2. Well the induction and recovery from epidural anesthesia with ropivacaine HCl was remarkably smooth and without any event in group II.

Similar findings were earlier noted by Araujo *et al.* (2012) who concluded that ropivacine produces prolonged bilateral perineal analgesia with minimal ataxia in standing cattle.

## 4.4 Observations during Surgery

### 4.4.1 Physiological parameters

#### 4.4.1.1 Heart rate (beats per minute)

The changes in the heart rate associated with epidural anesthesia with lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II are shown in Table no. 4.8 and Fig.4

In group II a gradual and non significant decrease in heart rate was observed which reached normal base value at the end of the study. In group I gradual and non significant decrease in heart rate was observed upto 60 minutes which reached normal base value at the end of the study.

The comparison within the group and between the groups at different intervals of the present study revealed that there was no significant ($P>0.05$) difference in the heart rate. The heart rate fluctuated within normal physiological limits at all the intervals of the study and in both the groups of animals.

Both ropivacaine hydrochloride and lignocaine hydrochloride produced mild non significant depression of heart rate in the present study.

Singh *et al*. (2005) also observed decrease in heart rate in goats @ 0.6 mg/kg body weight. Contrary to this Bashir *et al*. (2011) observed significant (P≤0.05) decrease in heart rate with lignocaine @ 0.5 mg/kg. Decrease in heart rate by lignocaine might be due to paralysis of cardiac sympathetic fibers or generalised decrease in the sympathetic activity (Lumb and Jones, 1984). Skarda and Muir (1996a) in their study observed increase in heart rate after lignocaine administration in cattle which might be due to increase sympathetic activity to maintain cardiac output and systemic blood pressure.

#### 4.4.1.2 Respiratory rate (breaths per minute)

The changes in the respiratory rate (Breath / minute) associated with epidural anesthesia with lignocaine hydrochloride and ropivacaine hydrochloride are described in Table No. 4.9 and Fig.5

In animals of group II (ropivacaine), a gradual and non significant decrease in respiratory rate was observed upto 30 minutes post - injection; thereafter, it decreased significantly (P≤0.05) from 30 to 120 minutes with peak decrease at 60 minutes interval. In animals of group I (lignocaine) also non significant decrease in respiratory rate was recorded upto 30 minutes post injection; thereafter, it decreased significantly (P≤0.05) from 30 to 60 minutes with peak decrease at 90 minutes interval.

The comparison between the groups at different intervals of the present study did not reveal statistically significant (P>0.05) difference in the respiratory rate. The respiratory rate fluctuated within the normal physiological limits at all the intervals of the study and in both the groups of animals.

In both, group I and group II there was significant (P≤0.05) decrease in respiratory rate between 30 minutes to 120 minutes in group I and between 30 minutes to 60 minutes in group II. Similarly Singh *et al*. (2005) observed significant decrease in respiratory rate from basic value at 15 minutes (P≤0.05). Skarda and Muir (2001) recorded depression of respiratory rate in mares after epidural administration of ropivacaine. Similar results have also been reported by Skarda and Muir (1982a) in cattle, Skarda and Muir (1982b) in horses and Tendillo *et al*. (1995) in pigs.

#### 4.4.1.3 Rectal temperature (°F)

The changes in rectal temperature (Degrees Fahreneit) associated with epidural anesthesia with lignocaine hydrochloride and ropivacaine hydrochloride are mentioned in Table No. 4.10 and Fig.6

In animals of group II (ropivacaine) a gradual and non significant decrease in rectal temperature was observed upto 30 minutes post-injection, thereafter, it decreased significantly (P≤0.05) from 60 to 90 minutes with peak decrease at 90 minutes interval. There after rectal temperature fluctuated within normal limit. Animals of group I (lignocaine) also showed non significant decrease in rectal temperature throughout the observation period.

The comparison between the groups at different intervals of the present study did not reveal statistically significant (P>0.05) difference in the rectal temperature. The rectal temperature fluctuated within the normal physiological limits at all the intervals of the study and in both the groups of animals.

Animals of ropivacaine group showed non significant (P>0.05) decrease in rectal temperature upto 60 minutes post injection and showed significant (P≤0.05) decrease from 60 minutes to 120 minutes. While Amarpal *et al*. (2007) and Singh *et al*. (2005 a) observed no significant difference in rectal temperature in buffalo calf Animals of group I (lignocaine) showed non significant decrease (P>0.05) in rectal temperature throughout the observation period. Skarda and Muir (1982a), Skarda and Muir (1982b) and Mishra *et al*. (1993) reported hypothermia in cattle, horse and buffaloe respectively.

**Table 4.8 Mean ± SE of Heart rate (beats per minute)**

| Intervals in Minutes | Group I | Group II |
|---|---|---|
| 0 | 58.50 ± 1.34 | 58.33 ± 1.31 |
| 15 | 59.83 ± 1.55 | 60.16 ± 1.34 |
| 30 | 57.16 ± 1.65 | 57.16 ± 1.25 |
| 60 | 57.16 ± 1.80 | 56.33 ± 1.45 |
| 120 | 59.16 ± 1.60 | 56.50 ± 1.73 |

*Means bearing superscript* differ significantly (P≤0.05) from 0 minute within the group.

**Means bearing superscript** differ significantly (P≤ 0.01) from 0 minute within the group.

**Table 4.9 Mean ± SE of Respiratory rate (breaths per minute)**

| Intervals in minutes | Group I | Group II |
|---|---|---|
| 0 | 19.50 ± 0.89 | 20.16 ± 0.63 |
| 15 | 17.66 ± 0.84 | 18.66 ± 0.53 |
| 30 | 17.16 ± 0.70* | 18.16 ± 0.60* |
| 60 | 16.16 ± 0.92* | 16.66 ± 0.63* |
| 120 | 18.83 ± 0.93 | 18.50 ± 0.82* |

*Means bearing superscript* differ significantly (P≤0.05) from 0 minute within the group.

**Means bearing superscript** differ significantly (P≤ 0.01) from 0 minute within the group.

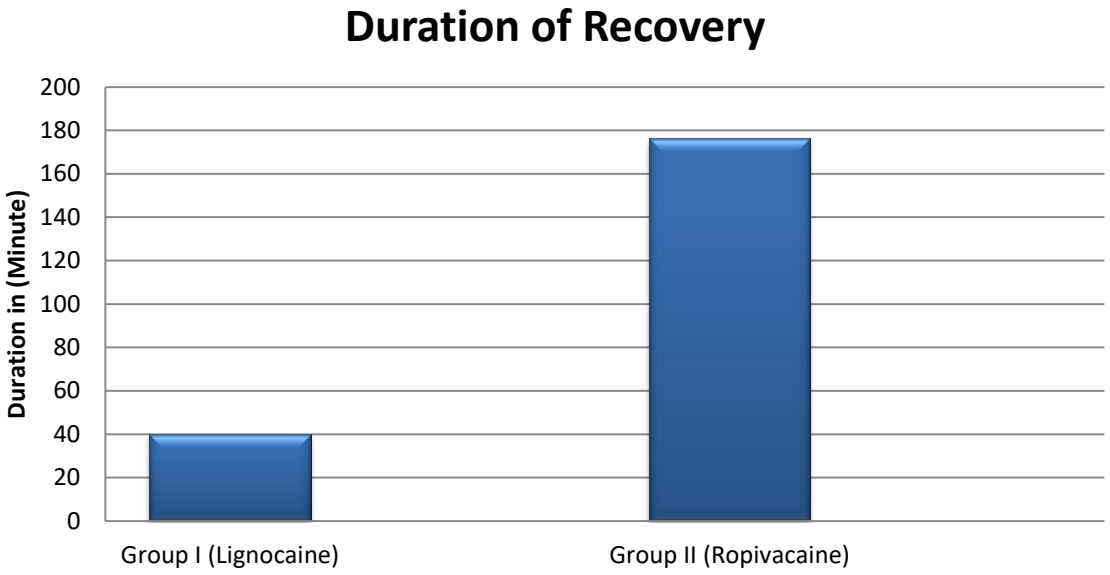



**Fig. 3 : Duration of Recovery in animals of both groups**

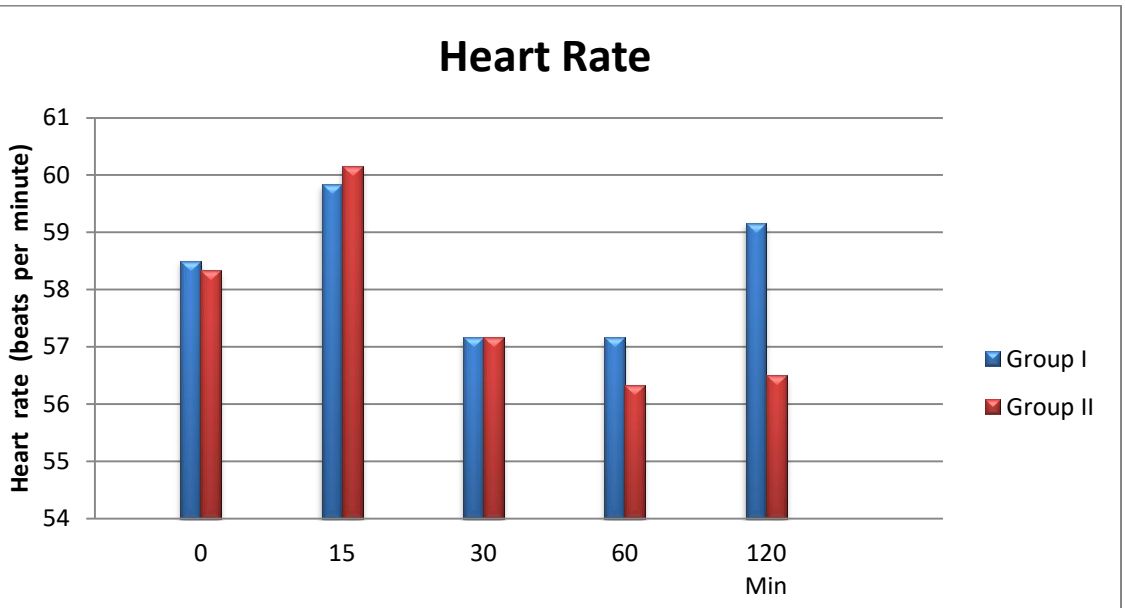



**Fig. 4 : Herat rate recorded in both groups at different intervals**

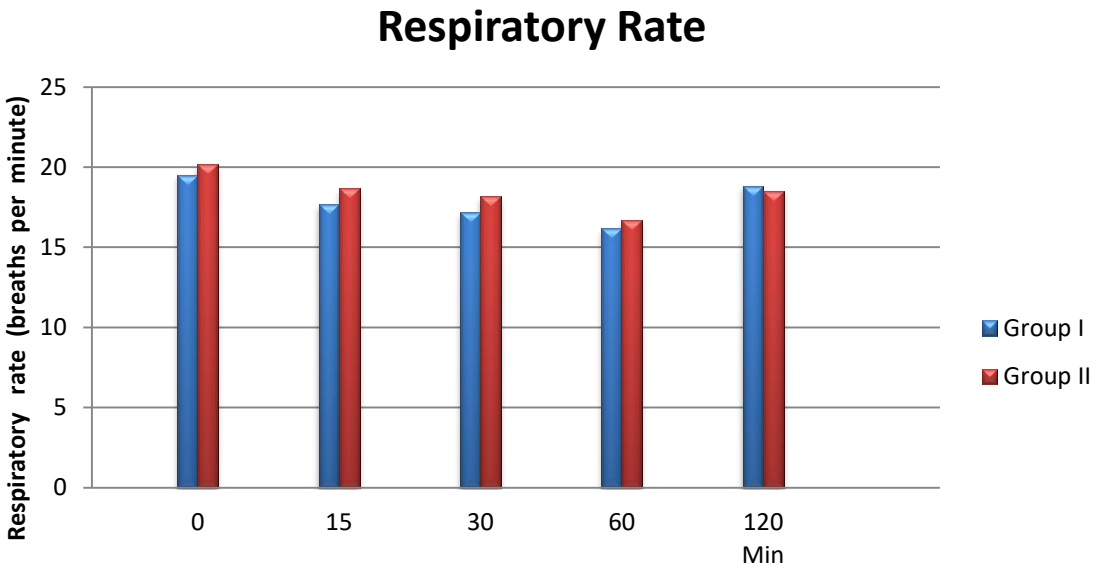



**Fig. 5 : Respiratory rate recorded in both groups at different intervals**

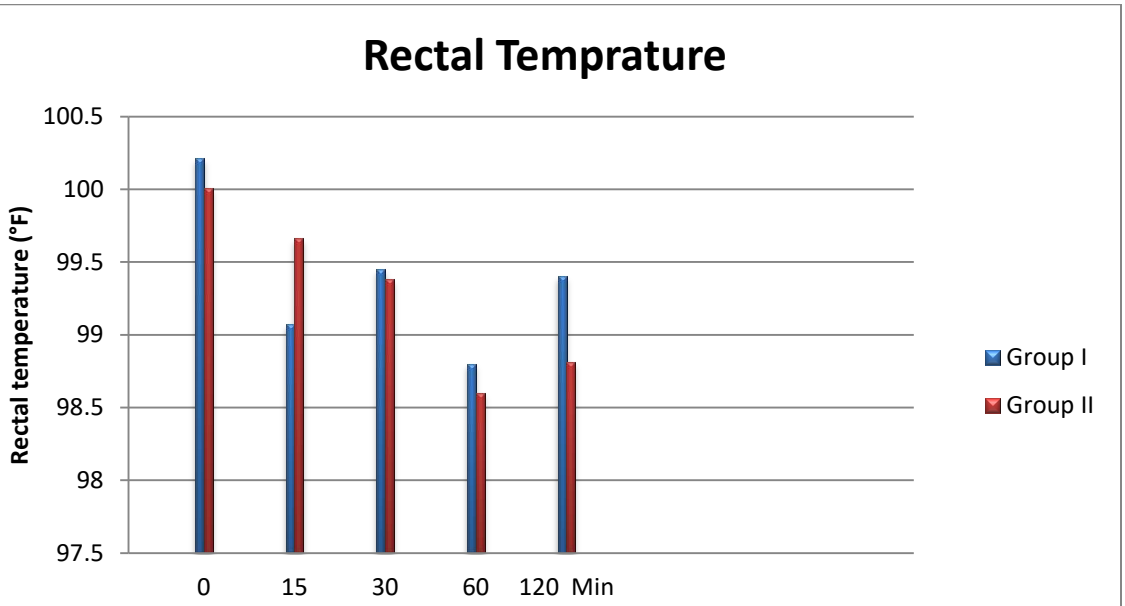



**Fig. 6 : Rectal temperature recorded in both groups at different intervals**

**Table 4.10 Mean ± SE of Rectal temperature (°F)**

| Intervals in Minutes | Group I | Group II |
|---|---|---|
| 0 | 100.21 ± 0.52 | 100.01 ± 0.40 |
| 15 | 99.07 ± 0.45 | 99.660 ± 0.57 |
| 30 | 99.45 ± 0.47 | 99.38 ± 0.29 |
| 60 | 98.8 ± 0.54 | 98.60 ± 0.28* |
| 120 | 99.40 ± 0.37 | 98.81 ± 0.38 |

*Means bearing superscript* differ significantly (P≤0.05) from 0 minute within the group.

**Means bearing superscript** differ significantly (P≤ 0.01) from 0 minute within the group.

### 4.5 Haematological parameters

The changes in the haemoglobin (g/dl), Packed Cell Volume (%), Total leucocyte count and Total erythrocyte count associated with epidural; anesthesia using lignocaine hydrochloride and ropivacaine hydrochloride are exhibited in Table No. 4.11.

#### 4.5.1 Haemoglobin (g/dl)

The mean hemoglobin values before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were; 10.29 ± 0.15 and 10.17 ± 0.16 respectively and mean ± SE values, 120 min after the anaesthesia in group I and II were; 9.55 ± 0.17 and 9.65 ± 0.14 respectively (Fig.7)

The comparison between the groups at different intervals of the present study did not reveal any statistically significant (P>0.05) difference in the haemoglobin levels. However, within the group I between 0 to 120 min intervals showed statistically significant (P≤0.05) difference in the haemoglobin levels however, fluctuation was within the normal physiological limits.

### 4.5.2 Packed cell volume (%)

The mean values of packed cell volume (%) before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were; 32.47 ± 0.25 and 32.45 ± 0.26 respectively and mean ± SE values 120 min after the anaesthesia in group I and II were; 31.58 ± 0.21 and 31.75 ± 0.31 respectively (Fig.8).

The comparison between the groups at different intervals of the present study revealed that there was no statistically significant ($P>0.05$) difference in the PCV values. However within the group I, between 0 and 120 min intervals, significant ($P\leq0.05$) difference in the PCV values was observed however, fluctuation was within the normal physiological limits.

### 4.5.3 Total Leukocyte Count (thousands/µl)

The mean values of Total leukocyte count (thousand/µl) before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were; 8.08 ± 0.20 and 8.06 ± 0.18 respectively and mean ± SE values 120 min after the anaesthesia were; 7.06 ± 0.22 and 7.11 ± 0.16 respectively in group I and II (Fig.9).

The comparison within the group and between the groups at different intervals of the present study revealed that there was no significant ($P>0.05$) difference in the TLC values. The TLC values fluctuated within the normal physiological limits at all the intervals of the study and in both the groups of animals.

**Table 4.11 Mean ± SE values of Hb(g/dl), PCV (%), TLC(X10$^3$/µl) in both the groups of local anaesthetics**

| Sr. No. | Parameters* | Minutes | Group I | Group II |
|---|---|---|---|---|
| 1 | Haemoglobin (g/dl) | 0 | 10.29 ± 0.15 | 10.17 ± 0.16 |
| | | 120 | 9.55 ± 0.17 | 9.65 ± 0.14* |
| 2 | Packed cell volume (%) | 0 | 32.47 ± 0.25 | 32.45 ± 0.26 |
| | | 120 | 31.58 ± 0.21 | 31.75 ± 0.31** |
| 3 | Total Leukocyte Count (×10$^3$ /µl) | 0 | 8.08 ± 0.20 | 8.06 ± 0.18 |
| | | 120 | 7.06± 0.22 | 7.11 ± 0.18 |

*Means bearing superscript* differ significantly (P≤0.05) from 0 hour within the group.

**Means bearing superscript** differ significantly (P≤ 0.01) from 0 hour within the group.

### 4.5.4 Differential Leukocyte count (Table 4.12)

#### 4.5.4.1 Neutrophils (%)

The mean values of neutrophils (%) before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were 34.44 ± 0.50 and 34.54 ± 0.66 in groups I and II respectively and mean values were; 34.34 ± 0.30 and 34.54 ± 0.53 in group I and II respectively after 120 min of anaesthesia (Fig.10).

The comparison within the group I and group II revealed that the neutrophils values fluctuated within the normal physiological limits at all the intervals of the study and in both the groups of animals.

#### 4.5.4.2 Lymphocytes (%)

The mean values of lymphocytes(%) before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were; 56.30 ± 0.90

and 56.50 ± 0.56 in groups I and II respectively and mean values were; 55.00 ± 0.38 and 55.50 ± 0.65 in group I and II respectively after 120 min of anaesthesia (Fig.11).

The comparison within the groups revealed that lymphocytes level fluctuated within the normal physiological limits in both the groups of animals and at all the intervals of study.

**4.5.4.3 Monocytes (%)**

The mean values of Monocytes(%) before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were; 3.00 ± 0.29 and 2.80 ± 0.34 and in groups I and II respectively and mean values 2.60 ± 0.21 and 2.81 ± 0.34 in groups I and II respectively after 120 min of anaesthesia (Fig.12).

Monocytes level fluctuated within the normal physiological limits in both the groups of animals and at all the intervals of the study.

**4.5.4.4 Eosinophils(%)**

The mean values of Eosinophil(%) before administration of lignocaine hydrochloride in group I and ropivacaine hydrochloride in group II were; 1.33 ± 0.48 and 1.43 ± 0.34 in groups I and II respectively and mean values were; 1.03 ± 0.40 and 1.41 ± 0.33 in group I and II respectively after 120 min of anaesthesia (Fig.13).

Eosinophils level fluctuated within normal physiological limits in both the groups of animals and at all the intervals of study. There was no significant difference in eosinophils level between the groups and within the groups at the different intervals.

In Group II non significant decrease in haemoglobin and packed cell volume was recorded. Similar findings were recorded after epidural administration of bupivacaine in goats by Pathak (1999) and Singh (2000). Wanger *et al*. (1991) reported decrease in PCV and haemoglobin during the period of anaesthesia or sedation might also be due to shifting of fluid from extra vascular compartment to intra vascular compartment.

The above observation suggested that ropivacaine has no adverse effect on the haematological parameters.

**Table 4.12 Mean ± SE values of Differential leukocyte count in both the groups of buffaloes before and after epidural anaesthesia**

| Sr. No. | Parameters | Minutes | Group I | Group II |
|---|---|---|---|---|
| 1 | Neutrophils (%) | 0 | 34.44 ± 0.50 | 34.54 ± 0.66 |
| | | 120 | 34.34 ± 0.30 | 34.54 ± 0.53 |
| 2 | Lymphocytes (%) | 0 | 56.30 ± 0.90 | 56.50 ± 0.56 |
| | | 120 | 55.00 ± 0.38 | 55.50 ± 0.65 |
| 3 | Monocytes (%) | 0 | 3.00 ± 0.29 | 2.80 ± 0.34 |
| | | 120 | 2.60 ± 0.21 | 2.81 ± 0.34 |
| 4 | Eosinophils (%) | 0 | 1.33 ± 0.48 | 1.43 ± 0.34 |
| | | 120 | 1.03 ± 0.40 | 1.41 ± 0.33 |

*Means bearing superscript* differ significantly (P≤0.05) from 0 hour within the group.

**Means bearing superscript** differ significantly (P≤ 0.01) from 0 hour within the group.

### 4.6 Observations regarding surgical interventions

The various clinical cases were treated under epidural anaesthesia in Group I and Group II shown in Plate 3 – 10.

In group I and in group II epidural administration of lignocaine hydrochloride and ropoivacaine hydrochloride produced optimal analgesia. The buffaloes did not show any signs of pain during the surgical procedure. In case of tail gangrene the procedure of amputation of tail and in case of prolapse the reposition of prolapsed mass of uterus lasted for 35to40 minutes in group I and II .

Succesful reduction ,reposition and retention of prolapsed mass of uterus was done in two buffaloes using 2% lignocaine hydrochloride in group I and in two buffaloes

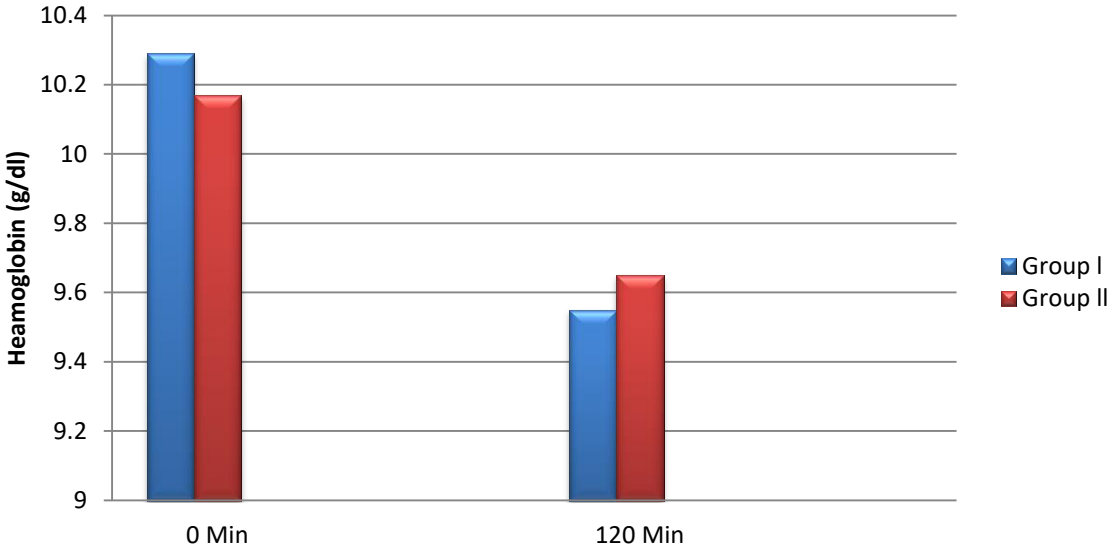



**Fig. 7: Haemoglobin in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

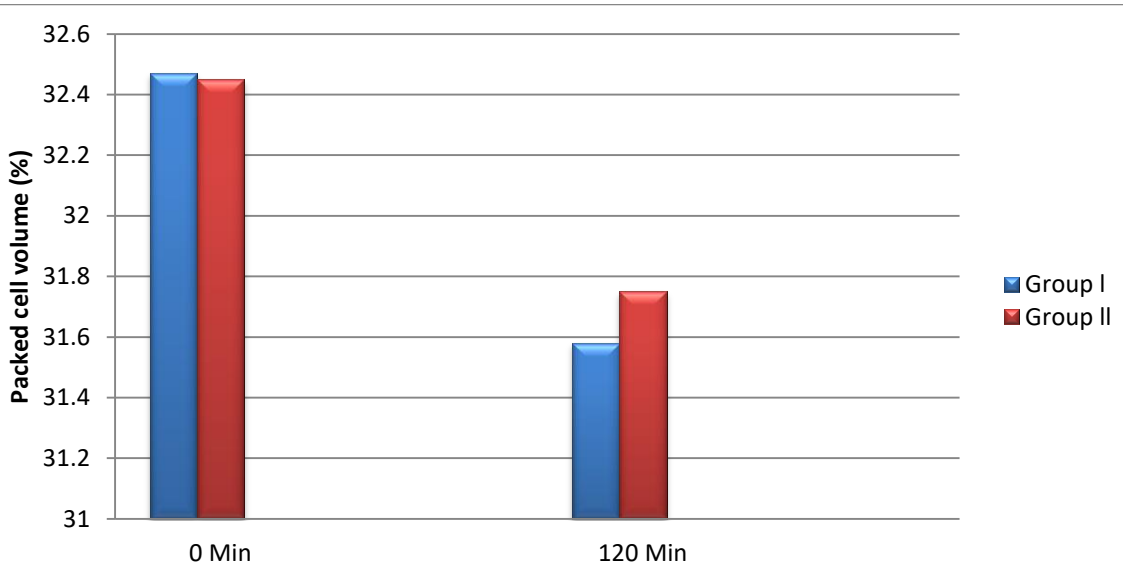



**Fig. 8: Packed cell volume (%) in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

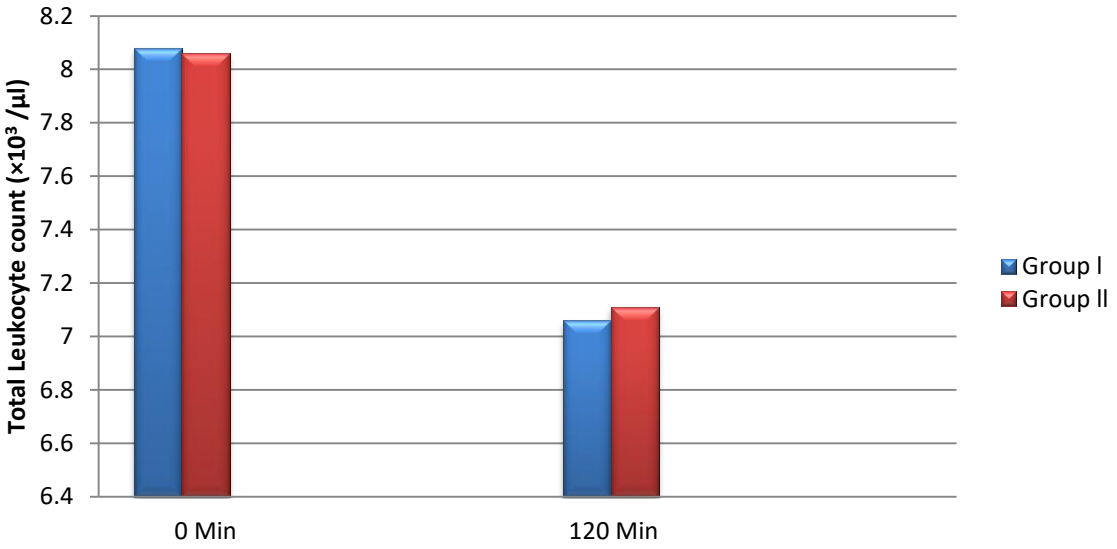



**Fig. 9: Total Leukocyte count in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

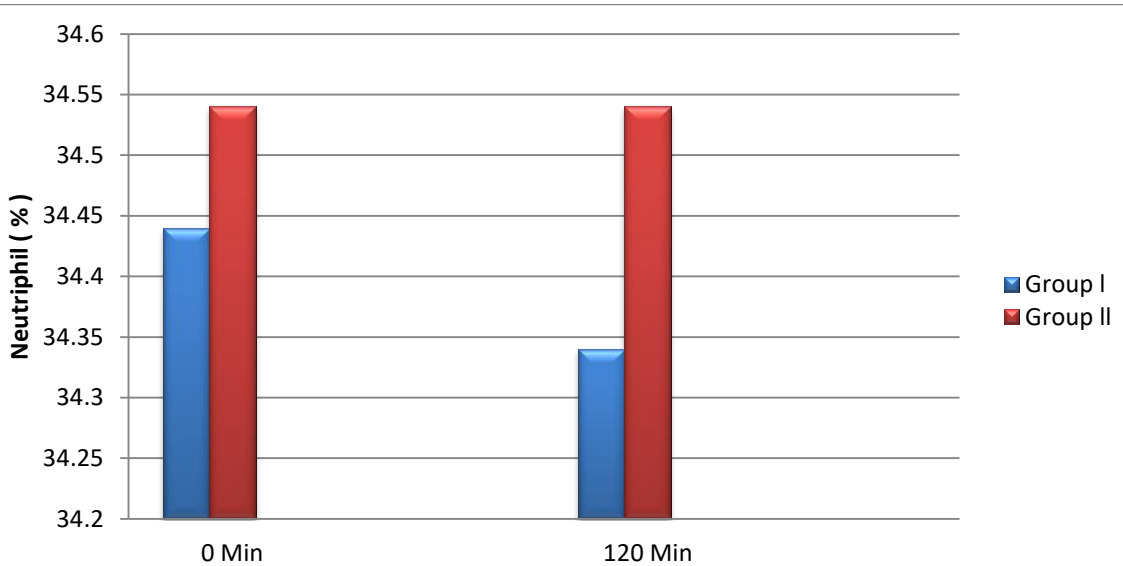



**Fig. 10: Neutrophil count in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

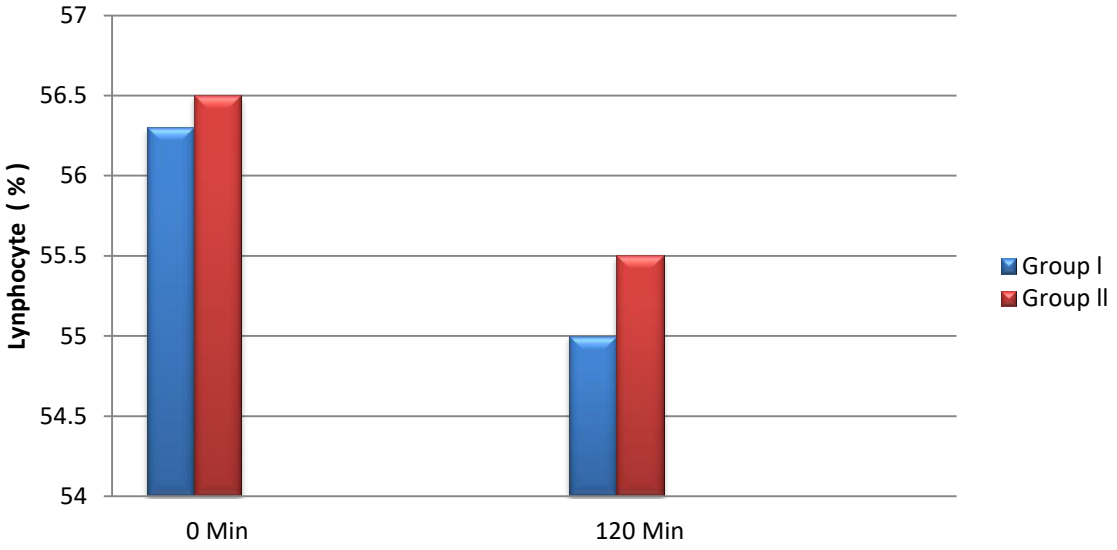



**Fig.11: Lymphocyte count in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

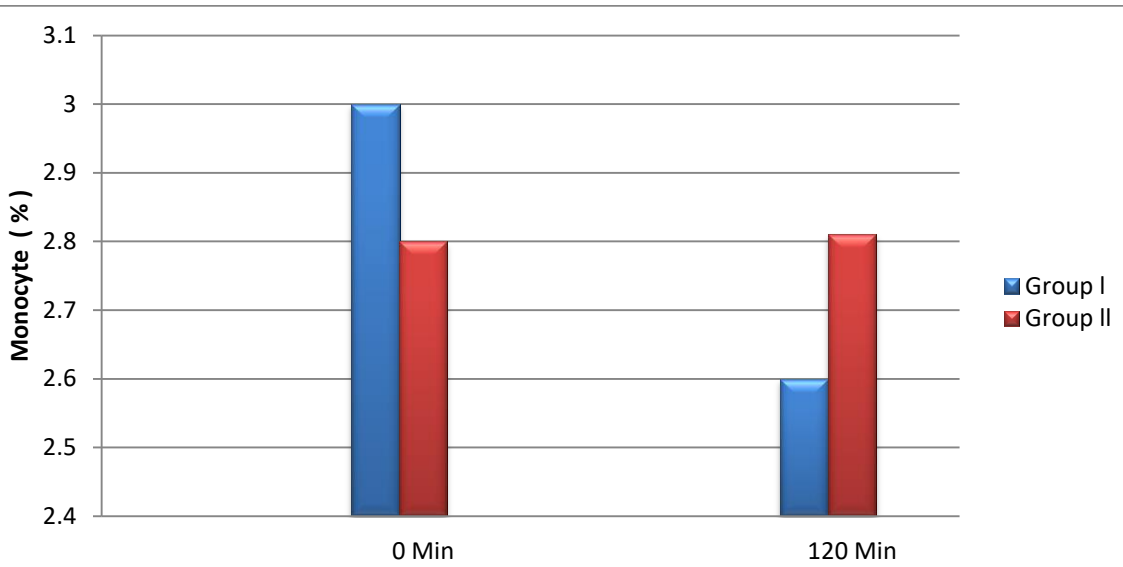



**Fig. 12: Monocyte count in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

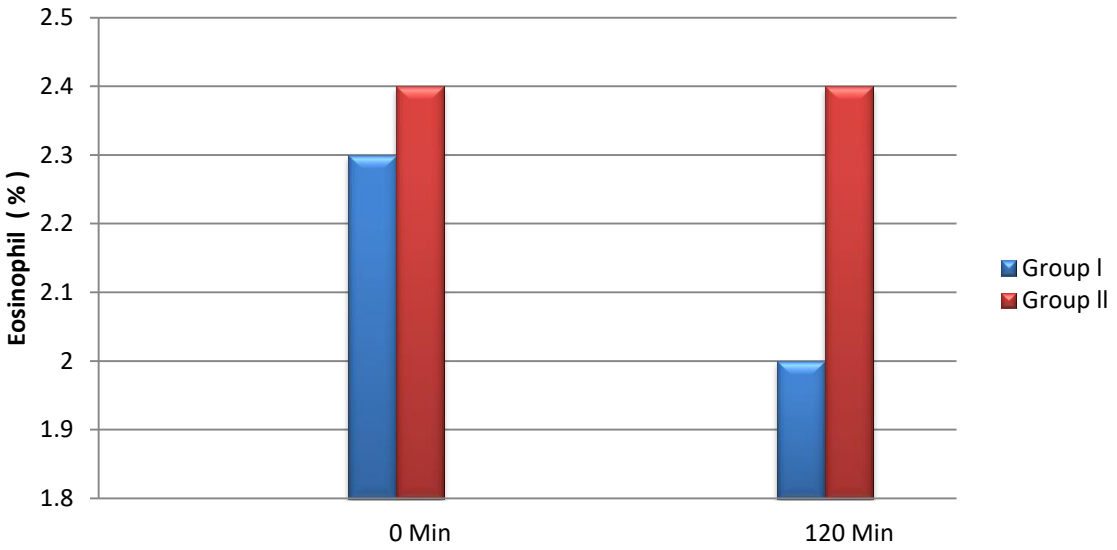



**Fig. 13 Eosinophil count in both groups of buffaloes at 0 and 120 minutes of anaesthesia**

using 0.75% ropivacaine hydrochloride analgesia in group II. In both the treatment groups no resistance was shown by the animal.

The area covered after administration of analgesic solution in both the groups for amputation of tail and management of uterine prolapse was from the caudal back to the area above the hock joint with no reflexes no sensation in the tail, buttock and thigh by using pinprick.

These findings were in agreement with the report of Choudhary and Dabas (2013) who achived caudal epidural analgesia using 5ml 2% lignocaine HCl solution in buffalo. They reported that no difficulty was encountered for replacement of the prolapse mass and the caudal epidural analgesia with 5ml 2% lignocaine HCl, was found enough to decrease the straining and desensitize the perineum.

Similarly four caesarian operations were performed in two buffaloes each in group I and II respectively. The time required for caesarian section after epidural the onset of analgesic effect lasted for 2.5 and 3 hours in the buffaloes treated with ropivacaine hydrochloride .However, buffalo treated with lignocaine hydrochloride showed straining and signs of pain after 2 hr. during the procedure of caesarian section leading to additional administration of 5 ml lignocaine hydrochloride.

The tail and the prolapsed mass was completely desensitized,relaxed and the prolapsed mass was soft in texture. On lifting the mass above the ischial arch the urine was drained leading to reduction in size of prolapsed mass which was then reposed to its position by using lubrication (CMC) which was further retained in position by using rope truss.

Dorsal lateral vaginal tear was observed in 4 buffaloes.Through the vaginal tear internal genitalia protruded out .Out of these 4 buffaloes two were treated with lignocaine hydrochloride and two with ropivacaine hydrochloride. The vaginal tear was apposed by continuous suture using chromic catgut no.2. Vaginal rupture or vaginal tear in buffaloes was earlier reported by Pentyla and Karuna (2016) who reported a case of protrusion of urinary bladder and partially involuted uterus through ruptured vagina in post parturient buffalo and its successful correction under caudal epidural anaesthesia by injecting 10 ml of 2% lignocaine hydrochloride to control the straining during the surgical procedure.

Response to pinpricks provided indications regarding depth of analgesia in different body regions during maintenances period. The scale of graded 0 to 3 helped in quantifying the degree of analgesia.

Lignocaine and ropivacaine HCl produced moderate to complete analgesia at tail, perineum, upper parts of hind limb and inguinal region however duration of analgesia was of shorter period. Further mild analgesia was recorded in flank with lignocaine HCl as well as ropivacaine HCl. Adetuji *et al*. (2002)and Jones (2001) recorded both lignocaine HCL and ropivacaine HCl blocked the condition of impulses at various sites after epidural injection. The suggested sites of epidural analgesia, conduction of impulses are the nerves distal to the dural sheaths after leaving the intervertebral foramena. The covered nerve roots and dorsal roots of ganglion within the spinal canal and the spinal cord itself by diffusion (Skarda *et al*., 1981).

In the present study one or a combination of these mechanisms might have played a role in blocking impulse conduction. Ropivacaine caused reversible inhibition of sodium ion influx and thereby blocked impulse conduction in nerve fibers. Ropivacaine was less lipophilic than bupivacaine and was iess likely to penetrate large myelinated motor fibers therefore it has selective action on the pain transmitting A and C nerves rather than A B fibers which were involved in motor function. The absorption of ropivacaine from the epidural space was complete and biphasic and kidney is the main excretory organ for ropivacaine accounting 86% of the excretion of drug in urine after epidural administration.

After working with this project, taking operation and reviewing the study these were findings about on the techniques desired below.

**4.7 Evaluation of the merits of the Technique A and Technique B for epidural Anaesthesia:**

The administration of ropivacaine through the small diameter catheter was taking more time and more pressure on the apparatus spinal needle and 2$^{nd}$ needle with catheter in first with adhesive tape in place. This necessitated certain experience and care to accomplish. However, once the operator was conversant with use and pressure or handling the assembly/kit in place it was found very convenient for the applicability to deal with the repeated episodes of the treatment in variety of the cases like those that have been dealt under the project. It was so and opposite thing to other technique B were experienced with Tech. A.

It was easy to operate for access of spinal or epidural space. Risks and difficulties minimized and with a little experience and skill the administration of epidural anaesthesia and recovery was achieved. Repeat inoculation/administration of injection were easy to give, without difficulties or much efforts with use of catheterization.

Observations and specimen collections of cerebrospinal fluid for further research was convenient.

Injury or trauma directly to the spinal structures and indirectly to hind quarters and region were minimized .In this study no such complications were noticed.

Haemorrhage, inflammation in the spinal cord was minimized as the handling repeated attempts and manipulation, for precise epidural /spinal analgesia were avoided under technique B.

Hall and Clarke (1991), Lumb and Jones (1984) have observed similar effects or events whereas under technique A the following difficulties and complications were noted.

Tail paralysis as complication was noted by Brook (1935). Hind limb incoordination, paresis was noted by Lumb and Jones (1984). Radial paralysis severe tympany, hypovolemia, peripheral or visceral shock were encountered by Wright and Arthur (1983).

Limited depth of analgesia, more drug quantity and more dose requirement was observed in technique A whereas no such needs were found under technique B because the drug could be precisely administered in epidural space with adaptation of technique B.

Further many times cases demanded anaesthesia to prolong for surgical treatment or even extend the area of analgesia to the certain distant away from perineum, such as flank, thigh, groin and thigh or hind limbs. These practically required controlling the hind limbs and sensations on urogenital structures .These needs were met and treatments accomplished in good manner. So as from the experience of the research projects, it can be boldly mentioned that, with additional/incremental dose of the inj. Ropivacaine under the technique B such treatments can be certainly undertaken.

The assembly or kit was designed and prepared locally and found very economically. The hassle of blood clotting in the catheter occasionally and application of more

pressure to administer the thick drug like ropivacaine could be overcome with the use of heparin and wider catheter.

# Chapter 5
# SUMMARY AND CONCLUSION

As a matter of fact epidural anaesthesia is often considered to be the best local anaesthetic choice with rare complications when good technique and reasonable precautions are employed .The use of epidural anaesthesia has increased over past few decades and became most popular for certain surgical and gynaecological procedures. When evaluating the local anaesthetic solutions and the technique used to produce the local anaesthesia, researchers usually compared the onset of time, duration and efficacy with those of previous techniques and the drugs used contemporarily. The technique used to deposit anaesthetic solution and the volume of the drug used to do, so is a crucial factor in improving the success rate and predictability of the epidural anaesthesia. Thus the ability to block the various body areas with smaller volume of local anaesthetic solution could add to the safety of the technique of epidural anaesthesia.

Present study has demonstrated to evaluate the efficacy of epidural administration of lignocaine hydrochloride and ropivacaine hydrochloride in buffaloes. Under aseptic precautions and by following epidural technique with and without catheterization, epidural anaesthesia was achived in 16 animals divided into two equal Groups i.e. Group I and Group II. In Group I 2% lignocaine hydrochloride @ 0.3mg/kg body wt. and 0.75% ropivacaine hydrochloride @0.3mg/kg body wt. in Group II were injected epidurally at the intercoccygeal space under aseptic condition. Anaesthesia was defined as a lack of response to needle pinpricks and hemostat pressure over the skin, s/c tissues underneath, in the region of the tail, anal and perineum region. Under aseptic precautions and by following the traditional technique of epidural anaesthesia was used in ten cases (Subgroup A) and epidural anaesthesia with catheterization technique B was used in six cases (Subgroup B).

All the cases were subjected to medico-surgico treatment. The per rectal examination, per vaginal examination and catheterization of urinary bladder and such prerequisite procedures were performed prior to treatment. Those who helped in assessment of quality of anaesthesia with regards to the features such

as relaxation of pelvic and urogenital musculature, behavior of animal and straining .

The cases were closely monitored for 36 to 46 hours, kept under observations for until clinical healing/ recovery (Usually 8 to 10 days) and followed upto 45 days. No events all the cases survived well and no untoward event or no any emergency or noticeable functional hindrance deforming occurred during the period of observation.

The duration of induction, duration of maintenance of analgesia and duration of recovery from the effects of the drugs were recorded in all the animals .Physiological observations such as heart rate ,respiratory rate and rectal temperature was recorded before and at 0.15 ,30,60 and 120 minutes after post injection. Haemogloin, packed cell volume, total leucocyte count, differential leucocyte count before and at 120 minutes of post injection using standard procedures.

The duration of induction was quicker with lignocaine hydrochloride (5.20±0.31 minutes) than ropivacaine hydrochloride (12.60±0.37 minutes). The duration of maintenance was longer with ropivacaine hydrochloride (382.40±4.82 minutes) than lignocaine hydrochloride (90.08±2.93 minutes). The duration of recovery in Group I was significantly (40.00±2.35) lower as compared to the time required for complete recovery in Group II buffaloes (176.21±12.83) minutes.

In Group I **satisfactory** analgesia at tail, perineum, inguinal region ,and upper part of hind limbs was observed till end of the observation period. However in Group II **good** analgesia at tail, perineum, inguinal region and upper parts of hind limbs was observed .The analgesia at flank was never complete at any stage in either Group. In both Groups analgesia at flank region even during peak period was only very mild.

Ropivacaine hydrochloride produced mild, negligible in coordination of hind limbs throughout the period of observation and there was no sternal recumbency in any animal of Group II. Lignocaine on the other hand, produced mild to moderate incoordination during walking. Four animals attained sternal recumbency for few minutes then these animals could stand however showed

incoordination during walking. Complete recovery took place in all animals of both Groups. The recovery was faster in Group I than Group II.

The physiological parameters like rectal temperature, heart rate and respiratory rate showed fluctuation within normal physiological range throughout the observation period. These parameters showed non-significant decrease and reached the normal baseline by the end of the observation period.

The haematological parameters like haemoglobin, packed cell volume and total erythrocyte count were within the normal range. The parameters in both Groups (I and II) decreased from 0 hour to 120 minutes. However, significant decrease in haemoglobin and packed cell volume was observed in Group I which might be due to shifting of fluid from extra vascular compartment into intra vascular compartment in order to maintain normal cardiac output.

A significant rise in neutrophils and non significant fall in lymphocytes count was recorded in both the Groups. Monocytes and eosinophils showed non-significant fluctuations within the normal range in both the Groups at all the interval.

The surgical treatments involving the area at certain distant away from perineum such as flank, thighs or groin and those required for controlling of hind limbs, stopping the struggling, minimizing kicking and avoiding straining could be safely and neatly achievements under technique B.

Repeated inoculation were far convenient under catheterization. A good control on the depth and time of analgesia was obtained by keeping the kit in site with adhesives. The prolonging of epidural anaesthesia, either in standing or occasionally in recumbency for caesarean operation or torsion treatment was smoothly/easily practiced with the technique B.

No injury or trauma to any spinal structure and no untoward signs until the duration of project were observed with catheterization Tech. B.

Epidural analgesia under tech. B with the locally prepared kit was highly economic and useful

**Based on the above findings following conclusions were made**

1. Epidural administration of lignocaine hydrochloride produced quicker (5.20±0.31 min) onset of analgesia than ropivacaine hydrochloride (12.60±0.37min).

2. Ropivacaine hydrochloride produced significantly longer duration of maintenance (382.40±4.82 min) than that of lignocaine hydrochloride (90.08±2.93min) thus can be used for longer duration of surgeries.
3. Ropivacaine hydrochloride was associated with negligible motor incoordination of hind limbs than that of lignocaine hydrochloride. Thus pelvic, urogenital, perineal manipulations and operations can be conveniently performed, maintain standing position under epidural anaesthesia with its use.
4. The technique B of epidural anaesthesia with catheterization was far convenient than Tech. A, for repeated administration of incremental dose to prolong the duration and extend the area of analgesia. It provided better control over the procedure than traditional technique A.
5. The kit used for epidural anasestehsia with Tech. B can be easily prepared and is highly economic and useful.
6. Both ropivacaine hydrochloride and lignocaine hydrochloride produced non- significant decrease in heart rate, total leucocyte count and differential leucocyte count.
7. Significant decrease was recorded in rectal temperature, respiratory rate, haemoglobin and packed cell volume with ropivacaine however, these values fluctuated within normal physiological limits in both the Groups.
8. Both ropivacaine hydrochloride @ 0.3 mg/kg and lignocaine hydrochloride @ 0.3 mg/kg body weight are safe and effective for epidural anaesthesia in buffaloes. However, ropivacaine HCl is superior because of its longer (382.40±4.82 min) duration of action, better quality of anaestheisa and is recommended for use in clinical cases.

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## VITAE

The author Dr. Shaikh Azmat Shaikh Maulana was born on 15 June 1978 at Biloli, Tq. Biloli Dist. Nanded. He has passed his SSC examination in the year 1993 from ZPHS, Biloli Tq.Biloli Dist. Nanded and HSC Examination in the year 1995 from Mahatma Phule Junior College, Shekapur Tq . Kandhar Dt. Nanded.

Further he has admitted for BVSc & AH due to awareness and interest in animal science in college of veterinary and animal sciences Parbhani in 1995-96 and completed B.V.Sc & A H. degree course in September 2002. Actively participated in NCC and NSS during his undergraduate studies.

In the year 2007 he has joined as Livestock Development Officer in Animal Husbandary department, Govt. Maharashtra. In 2015-16 has joined for post graduate studies to Dept. Veterinary Surgery and Radiology.

## THESIS ABSTRACT

| | | |
|---|---|---|
| a) | Title of Thesis | **:**Efficacy of ropivacaine HCl and lignocaine HCl for epidural anaesthesia in buffalo |
| b) | Full Name of Student | **:** Mr. Shaikh Azmat Shaikh Maulana |
| c) | Name & Address of Major Advisor | : Dr. C.L. Badgujar<br>Associate Professor & Head,<br>Dept. of Surgery & Radiology<br>College of Veterinary and<br>Animal Sciences, Udgir, Dist.Latur (MS) |
| d) | Degree to be awarded | : M.V.Sc. |
| e) | Year of award of degree | **:** 2017 |
| f) | Major Subject | : Veterinary Surgery and Radiology- |
| g) | Total No. of pages in thesis | **:** 60 |
| h) | Number of words in abstracts | **:**445 |
| i) | Signature of the student | **:** |
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## ABSTRACT

The buffalo occupy a unique place in the agricultural economy of our country. Surgical conditions viz tail gangrene, urolithiasis, prolapse of vagina, uterus and cervix, dystokia, cervicovaginal tear, vaginal tumor are very common affections and require painless, straining free surgical conditionsfor management which can be conveniently accomplished under epidural anaesthesia. Present study has demonstrated to the evaluation of the efficacy of epidural administration of lignocaine hydrochloride and ropivacaine hydrochloride in buffaloes. The study

was conducted on the clinical cases referred for treatment to the Dept. of VSR and TVCC at College of Veterinary and Animal Sciences Udgir from distant places.

Epidural anaesthesia was performed on 16 buffaloes dividing them into two groups by using lignocaine hydrochloride (2%) @0.3mg/kg body weight (Group I) and Ropivacaine hydrochloride (0.75%) @0.3mg/kg body weight (Group II). Under aseptic precautions and by following the traditional technique of epidural anaesthesia was used in ten cases (Subgroup A) and epidural anaesthesia with catheterization technique B was used in six cases (Subgroup B).

The technique B of epidural anaesthesia with catheterization was far convenient than Tech. A, for repeated administration of incremental dose to prolong the duration and extend the area of analgesia. It provided better control over the procedure than traditional technique A. The kit used for epidural anasestehsia with Tech. B can be easily prepared and is highly economic and useful.

Grading of analgesia and recording of clinical parameters *viz,* heart rate, respiration rate and rectal temperature was done at 0,15,30,60,120 minutes after epidural anaesthesia while haematological parameters were evaluated before and 24 hrs after epidural anaesthesia. Anaesthesia was ascertained from lack of response to needle pinpricks and haemostat pressure over the skin and subcutaneous tissues of the tail, anal, sacral and perineum region.

The duration of induction was quicker in group I (5.20+0,31minutes) when compared to group II (12.60+0.31minutes).Duration of maintenance of analgesia (382.40±4.82 min) at tail, perineum, upper parts of hindl imbs and inguinal region was longer in group II when compared to group I (90.08±2.93 min). Ataxia was noted in group I however, it was negligible pronounced in group II. Recovery was quicker in group I (40.00±2.35 min) than group II (176.21±12.83min). Heart rate, respiratory rate and rectal temperature decreased in both groups however fluctuation was within the normal physiological limits at all intervals of the study. Haematological changes were within normal physiological limits.

Based on result of this study, it was concluded that both lignocaine and ropivacaine HCl at the dose rate of 0.3mg/kg body weight are safe and effective drug for epidural anaesthesia in buffaloes and may be recommended for use in clinical case. For prolonged surgeries ropivacaine hydrochloride may be selected as the drug of choice.

## प्रबंध सारांश

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|---|---|---|---|
| १. | प्रबंधाचे शिर्षक | : | लिग्नोकेन हायड्रोक्लोराइड व रोपीव्हॅकेन हायड्रोक्लोराइड यांची म्हशीमध्ये कंबरेतील मज्जारज्जुवरील बधीरीकरणाची परिणामकारकता. |
| २. | विद्यार्थ्याचे पुर्ण नाव | : | शेख अजमत शेख मौलाना |
| ३. | मार्गदर्शक | : | डॉ. च.ल. बडगुजर<br>विभाग प्रमुख<br>पशुशल्यचिकित्सा व क्ष किरण शास्त्र<br>पशुवैद्यक व पशुविज्ञान महाविद्यालय,<br>उदगीर (४१३५१७) जि. लातूर |
| ४. | संबंधीत पदव्युत्तर पदवी | : | एम.व्ही.एस.सी. |
| ५. | पदवीदानाचे वर्ष | : | २०१७ |
| ६. | मुख्य विषय | : | पशुशल्यचिकित्सा व क्ष किरण शास्त्र |
| ७. | प्रबंधाची एकूण पाने | : | ६० |
| ८. | सारांशचे एकुण शब्द | : | ३८५ |
| ९. | विद्यार्थ्याची स्वाक्षरी | : | |
| १०. | विभाग प्रमुख<br>(नाव, पत्ता व स्वाक्षरी | :<br>: | डॉ. च.ल. बडगुजर |

## प्रबंध सारांश :

**''लिग्नोकेन हायड्रोक्लोराईड व रोपीव्हॅकेन हायड्रोक्लोराईड यांची म्हशीमध्ये कंबरेतील मज्जारज्जुवरील बधीरीकरणाची परिणामकारकता.''**

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आपल्या देशाच्या अर्थव्यवस्थेत म्हशींचे स्थान विशेष आहे. शेपटीचे गॅग्रीन, मुत्रसंस्थेतील खडे, मायांग बाहेर येणे, वासरू जन्मण्याच्या वेळेचे अडथळे, गर्भाशयाला फाटणे, गर्भाशयातील गाठी या सारख्या शस्त्रक्रियांच्या आजाराचे प्रमाण सामान्यत: अधिक प्रमाणात आढळतात. त्यांच्यावर उपचार करण्यासाठी दर्द विरहित पिडा थांबविणे, मागील पाश्र्व भागांचे जोर करणे/थांबवणे अशा अवस्थेतची मज्जारज्जूवरील बधीरीकरणांच्या तंत्राची नितांत आवश्यकता असते. अशी अवस्था ढुंगणावरील मज्जारज्जुवरील बधीरीकरणाच्या तंत्राने प्राप्त करता येते. प्रसुत प्रबंधामध्ये अशा तंत्रज्ञानासाठी/या मज्जारज्जूवरील बधीरीकरणाच्या तंत्रासाठी इंजेक्शन लिग्नोकेन हायड्रोक्लोराइड व रोपीव्हॅकेन हायड्रोक्लेराइड या औषधांच्या उपयोगाचा परिणाम दर्शविलेले आहेत. प्रसुत संशोधन पशुशल्यचिकित्सा व क्ष किरण विभागांतर्गत, पशुवैद्यकिय महाविद्यालय उदगीर येथे करण्यात आले.

सोळा म्हशीमध्ये मज्जजरज्जुवरील बधीरीकरणाचे तंत्र वापरले, आठ म्हशींचे दोन गट करण्यात आले. एका गटात लिग्नोकेन हायड्रोक्लोराइड २% प्रमाणे व दुसऱ्या गटात रोपीव्हॅकेन हायड्रोक्लोराइड ०.७५% प्रमाणे इंजेक्शन @ 0.3mg/kg या मात्रेने वापरण्यात आले. जंतू विरहित पध्दतीने म्हशीमध्ये पारंपारीक तत्र — अ (उपगट अ) व कुपनलिकेद्वारे तंत्र—ब (उपगट ब) मध्ये वापरले. मज्जारज्जुवरील बधीरीकरणाचे तंत्र अ हे तंत्र ब पेक्षा खुपच सरस/उत्तम आढळून आले. त्यातंत्राद्वारे वारंवार इंजेक्शन देणे व बधीरीकरणाचा काळ वाढविणे, तसेच मणक्यावरील/जागेत इंजेक्शन देण्यावर नियोजन ठेवणे या गोष्टी उत्तमत: साध्य करण्यात आल्या. मज्जारज्जुवरील बधीरीकरणाचे तंत्र ब साठी स्थानीक पातळीवर एक संच उपकरण बनविले, ते बनविणे सुलभ व किफायतशीर आहे.

औषधांचे वेगवेगळे परिणाम ०, १५, ३०, ६० व १२० मिनिटे कालावधीनंतर मोजण्यात आले जसे छातीचे हृदयाचे ठोके, शरीर तापमान व श्वसनाचा वेग इ. तसेच इंजेक्शन/उपचारापुर्वी व चोविस तासानंतर रक्ताची तपासणी केली. संबंधीत शरीराच्या भागावर, सुई टोचून बधिरीकरण व्यवस्थीत झाले किंवा नाही हे तपासले.

गट एक मध्ये बधिरीकरणासाठी कमी वेळ (५.२०$\pm$ ०.३ मि.) तर गट दोन मध्ये अधिक वेळ (१२.६०$\pm$ ०.३१ मि.) लागला. बधिर अवस्थेचा काळ गट एक मध्ये ९०.०८ $\pm$ २.९३ मि. तर गट दोन मध्ये खुप जास्त वेळ, ३८२.४०$\pm$ ४.८२ मि. दिसुन आला. बधिर अवस्थेतून बाहेर पडण्याचा काळ गट एक मध्ये कमी ४०.००$\pm$ २.३५ मि. तर गट दोन मध्ये १७६.२१$\pm$ १२.८३ मि. होता. हृदयाचे ठोके, श्वसन क्रिया व शरीर तापमान वेळोवेळी काहीसे खालावले, परंतू ते सर्व सुस्थितीच्या प्रमाणात हद्दीत/मात्रेतच होते. रक्ताचे घटकही सुरळीत प्रमाणात राहिले.

या संशोधनाद्वारे असा निष्कर्ष काढण्यात येतो की, म्हशीमध्ये ०.३ mg/kg वजन या मात्रेने लिग्नोकेन हायड्रोक्लोराइड व रोपीव्हॅकेन हायड्रोक्लोराइड या औषधीचा वापर करकणे मज्जारज्जुवरील बधीरीकरणासाठी सुरक्षीत आणि परिणामकारक/उपयुक्त आहे म्हणून त्यांची शिफारस करण्यात येते. दिर्घकाळ शल्योपचारासाठी रोपीव्हॅकेन हायड्रोक्लोराइड या औषधाची निवड ही सर्वात अत्यंत उपयुक्त आहे.