Study on Xylazine As An Epidural Anaesthetic Agent For Correcting Surgical Affections In Camels (Camelus-dromedarius)

A THESIS
Presented to
The Faculty of Veterinary and Animal Science
Rajasthan Agricultural University
BIKANER-334001

In Partial Fulfilment of
the requirements for the degree
MASTER OF VETERINARY SCIENCE
(Surgery & Radiology)

By
Dr. Sobhagya Deep Sharma
B.V.Sc. & A.H.

February, 1994
STUDY ON XYLAzINE AS AN EPIDURAL ANAESTHETIC AGENT FOR CORRECTING SURGICAL AFFECTIONS IN CAMELS (Camelus-dromedarius)

M.V.Sc. Thesis,
Department of Surgery and Radiology,
College of Veterinary and Animal Science,
Rajasthan Agricultural University,
Bikaner- 334001.

Submitted by : Dr. Sobhagya Deep Sharma
Major Advisor : Dr. R.J. Choudhary

ABSTRACT

Camel suffers from several surgical affections involving hind-quarters, bone, tail, anus, rectum, vagina, perineum, penis and sheath. Mortality and resultant economic losses may also occur due to these surgical affections, if not treated in time. These can be corrected under epidural anaesthesia.

The study on epidural anaesthesia using xylazine hydrochloride was carried out in eighteen clinical cases of camels, divided into three dose rates comprising of six clinical cases of camels in each group. In first group, xylazine hydrochloride was administered at the dose rate of 0.1 mg/kg
body weight, epidurally. In second group, xylazine was administered at the dose rate of 0.2 mg/kg body weight. In third group, xylazine was administered at the dose rate of 0.3 mg/kg body weight, in identical way.

The induction period, extent and degree of anaesthesia, salivation, duration of anaesthesia and recovery period were recorded in each clinical case of camel.

With the dose regimen of 0.1 mg/kg body weight there was no significant effect on rectal temperature, pulse rate and respiration rate. With the dose rate of 0.2 mg/kg body weight there was non-significant change in respiration rate, but the rectal temperature and pulse rate were significantly decreased. However, it fell to the pre-administration level by four hours after administration. There was no significant effect on pulse rate with the dose regimen of 0.3 mg/kg body weight. Besides this, significant decrease in rectal temperature and respiration were observed.

Haematological study revealed non-significant changes in the parameters like Hb, PCV, and TLC, except TEC with all the dose rates. But, TEC values decreased significantly at intervals from 0 to 4 hours when 0.2 mg/kg body weight dose of xylazine was administered.

Biochemical study revealed non-significant changes in serum sodium and potassium with all these dose regimens. With
the dose rate of 0.1 mg/kg body weight, total serum protein and serum chloride values were unaffected. Similarly with the dose rates of 0.2 and 0.3 mg/kg body weight, there was non-significant change in serum chloride and total serum protein from induction period till 24 hours. But a significant fluctuation in the values of serum protein and serum chloride, of course transient, occurred at 2 hours and 4 hours but returned to normal in the end. The serum glucose level increased significantly from 2 to 24 hours, 0 to 24 hours and 2 to 4 hours after the administration of xylazine epidurally in the dose rate of 0.1, 0.2 and 0.3 mg/kg body weight, respectively.

The present study indicated that the xylazine hydrochloride is an effective anaesthetic agent which can be safely administered epidurally in clinical cases of camels.
उद्देश्य (केमेलस-स्कूलिटिया) में सत्य विविधता समन्वयी विवरणों के प्रेरण के लिए एपृत्तुप उपदेश के रूप में 'जालजीन' का अनुसरण

नामकरण सूचक पत्र,
शिक्षा विविधता एवं विविधताको जिज्ञासा,
पत्र विविधता एवं पत्र विविधता महाविद्यालय,
सचिवालय कृति विविधताको जीवनरूप.

अनुरुप

डॉ. तैयम येंप सर्नार
डॉ. अर.वे. आर्फनी

अनुलोक

उद्देश्य पत्र-पत्रिका, अर्णप, पूंज, गुद, घोंग उल्लोक-वेल, विवरण एवं विवरण कुलकुल के अनेक सत्य विवरणों से प्रशिक्षण रहता है। समय पर उपरांत न हो सके पत्र के कारण यह सत्य विवरण उद्देश्य में बृहद्ध एवं आवश्यक होने के कारण बन जाते हैं। एपृत्तुप उपदेश के अधीन इन विवरणों को ठीक विषय व वक्ता है।

अनुरुप शब्दांकि तथा में कड़े को तीन विवरण अनुसार के समूह में विनियमित करने, जिसमें प्रत्येक समूह में छः उद्देश्य समन्वयी किये गये, जहाँजीन बार्केस्लायड को एपृत्तुप उपदेश के रूप में समूह तेज अनुसरण किया गया। प्रश्न समूह के छः शब्दांकिक उद्देश्य में जालजीन 0.1 गिल्लोग्राम/किलोग्राम उन्नतिक भार की दर से एपृत्तुप उपदेश की गयी। दूसरे समूह के 4 उद्देश्य में जालजीन 0.2 गिल्लोग्राम/किलोग्राम उन्नतिक भार की दर से एपृत्तुप उपदेश की गयी।

दूसरे समूह के छः उद्देश्य के समूह में जालजीन 0.3 गिल्लोग्राम/किलोग्राम उन्नतिक भार की दर से एपृत्तुप उपदेश की गयी।

प्रत्येक शैक्षिक उद्देश्य में प्रश्न जा, निवेदन तथा निवेदन, सार तर्क, निवेदन का अर्थ एवं सारपत्र प्रश्नी अर्थ अनुशीलित की गयी।

0.1 गिल्लोग्राम/किलोग्राम उन्नतिक भार की दर से निवेदन किये गये समूह में गुद मनोक, सन्तर एवं रचनाः दर में सम्बंध सार्वजनिक भाषा ही प्रतिष्ठित गयी। 0.2 गिल्लोग्राम/किलोग्राम उन्नतिक भार की दर से रचना दर पर सम्बंध सार्वजनिक भाषा नहीं प्रतिष्ठित
गया । लेकिन 0.2 मिलीग्राम/किलोग्राम शरीरिक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं उसके स्वर वातावरण में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने एवं सप्तद दर में महालपुर नियमात्मक भार को दर से गुद्ध लागू करने ।

लोकप्रेम अध्ययन के दौरान समय अनुपयोग समूहों में कुल रक्त वोक्स समपन के अलावा अन्य प्रयोगों जैसे नाशपत्त, संचारित प्रोटोस्य समपन के अनुप्रयोग में कोई महालपुर मतदान नहीं घटने गये । ने परिस्थिति 0.4, 0.2 एवं 0.1 मिलीग्राम/किलोग्राम शरीरिक भार को दर से दर में अपहरणस्मृति बढ़ने गये । लेकिन 0.2 मिलीग्राम/किलोग्राम शरीरिक भार को दर से 0 से 0.5 फ्रेंट के अवधारण पर कुल रक्त वोक्स समपन में महालपुर नियमात्मक भार गये।

विष-रासायनिक अध्ययन के दौरान इन समी प्रयोग समूहों में लगभग खाली एवं दक्षिण में महालपुर नियमात्मक भार को दर से कुल लगभग प्रोटोस्य एवं लगभग नीरोस्य के परिणाम अनुसार रहे । इसी प्रयोग से 0.2 मिलीग्राम/किलोग्राम एवं 0.1 मिलीग्राम/किलोग्राम शरीरिक भार को दर से प्रोटोस्य-खाली से 24 फ्रेंट परमाणु एवं कुल लगभग प्रोटोस्य एवं लगभग नीरोस्य में भी महालपुर नियमात्मक भार गये। लेकिन लगभग प्रोटोस्य एवं लगभग नीरोस्य में 2 एवं 4 फ्रेंट पर महालपुर नियमात्मक भार गये जो कि अन्त में समय रक्त पर आ गये । 0.1, 0.2 एवं 0.1 मिलीग्राम/किलोग्राम शरीरिक भार को नियम दर से एक्स्टेंडर प्राइजज्ज अनुप्रयोग करने के 2 से 24 फ्रेंट, 0 से 24 फ्रेंट एवं 2 से 7 फ्रेंट के परमाणु लगभग मुंह स्वर में महालपुर मुंह भार गये।

चर्चा अध्ययन के अनुसार यह निष्कर्ष निकलता है कि आइकमन लक्ष्यों का प्रयोग को सार्वजनिक अवधारण के लिए प्रभावित एवं सुरक्षित निष्क्रिय नाक रूप में उपयोग है।
certified that Dr. Sobhagya Deep Sharma has successfully completed COMPREHENSIVE EXAMINATION held on 14.2.1933 as required under the regulations for the degree of MASTER OF VETERINARY SCIENCE.

(Dr. D. S. Chouhan)
Head
Department of Surgery and Radiology
RAJASTHAN AGRICULTURAL UNIVERSITY
BIKANER

CERTIFICATE - I I


This is to certify that the thesis entitled, "STUDY ON XYLAZINE AS AN EPIDURAL ANAESTHETIC AGENT FOR CORRECTING SURGICAL AFFECTIONS IN CAMELS (Camelus-dromedarius)" submitted for the degree of MASTER OF VETERINARY SCIENCE in the subject of VETERINARY SURGERY and RADIOLOGY OF THE RAJASTHAN AGRICULTURAL UNIVERSITY, BIKANER, is a bonafide research work carried out by Dr. Sobhagya Deep Sharma, B.V.Sc. & A.H. under my supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation have been fully acknowledged. The draft of the thesis was also approved by Advisory Committee on 10.2.94.

Head
Department of Surgery and Radiology

Major Advisor

Dean
College of Veterinary and Animal Science
Bikaner
This is to certify that the thesis entitled, "STUDY ON HYLAZINE AS AN EPIDURAL ANAESTHETIC AGENT FOR CORRECTING SURGICAL AFFECTIONS IN CAMELS (Camelus dromedarius)", submitted by Dr. Sobhagya Deep Sharma to the RAJASTHAN AGRICULTURAL UNIVERSITY, BIKANER in partial fulfilment of the requirements for the degree of MASTER OF VETERINARY SCIENCE in the subject of VETERINARY SURGERY and RADIOLOGY has been approved by the SATISFACTORY report of the EXTERNAL EXAMINER and conducting the ORAL EXAMINATION on the same.

Approved by:

Dr. R. J. Choudhary
Major Advisor

Advisor

Dean
Post Graduate Studies
Rajasthan Agricultural University
Bikaner

[Signature]

[Signature]
DEDICATED
TO MY
PARENTS
ACKNOWLEDGEMENTS

I feel proud to express my deep sense of gratitude to my Advisor Dr. R.J. Choudhary, Assistant Professor, Department of Veterinary Surgery and Radiology for his invaluable guidance, with whose constant inspiration and stimulating insight during the course of this investigation and ready availability even in odd hours, that this work has been a success. I have no words to express my deep sense of gratitude to Dr. D.S. Chouhan, Head, Department of Veterinary Surgery and Radiology for his excellent guidance, constructive criticism and for liberal assent to avail all the facilities required for this work.

I am highly indebted to Dean, College of Veterinary and Animal Science, Bikaner for providing the necessary facilities. I express my greatfulness to Dr. N.R. Purohit, Assistant Professor of Veterinary Surgery and Radiology and Dr. S.S. Sharma, Professor and Head of the Department of Obstetrics and Gynaecology, as members of my Advisory Committee and elderly affection, encouragement during the course of this investigation.

It is my great pleasure to acknowledge my indebtedness to Dr. (Mrs.) C.K. Sharma, Dr. P.R. Dudi and Dr. T.K. Gahlot, Assistant Professors, Department of Veterinary Surgery and Radiology for their superb co-operation and imminent help without which this venture would not have taken the present shape. It was with their constant inspirations, untiring
endeavour and ready availability even in odd hours that this work has been a success.

In no way less, I thank the technical and non-technical staff of Veterinary Surgery and Radiology for their co-operation.

I also express my gratitude to Drs. Alok Srivastava, Anil Partani, Arvind Mathur, Mrs. Bhawna Sudan, Gopal Singh, Narendra Sharma, Parveen Bishnoi, Rajeev Garg and Ranjeet Singh, M.V.Sc. students and also to Mr. Ravindra, Mr. Sarjeet Singh, Mr. Subhash Bari and Mr. Sunil Chawla undergraduate students for their possible help and co-operation during my research work.

The author takes this opportunity to express his appreciations for the efforts of Ajay Tyagi and Harish Chandra Shankhala of ACME Computers who worked untiringly to prepare this thesis in present form.

In the last, I venture to superscribe the deep heart felt indebtedness to my reverend parents and to my elder brothers who heartened me for this study.

(Dr. Sobhagya Deep Sharma)
LIST OF CONTENTS

From To

1. INTRODUCTION 1 5
2. REVIEW OF LITERATURE 6 47
3. MATERIALS AND METHODS 48 55
4. RESULTS 56 97
5. DISCUSSIONS 98 124
6. SUMMARY AND CONCLUSIONS 125 131
7. BIBLIOGRAPHY 132 152
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table No.</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Effect of epidural administration of xylazine on several clinical observations in clinical cases of camels.</td>
<td>57</td>
</tr>
<tr>
<td>2.</td>
<td>Evaluation of the extent and degree of epidural anaesthesia in camels with the dose rate of 0.1 mg/kg body weight.</td>
<td>62</td>
</tr>
<tr>
<td>3.</td>
<td>Evaluation of the extent and degree of epidural anaesthesia in camels with the dose rate of 0.2 mg/kg body weight.</td>
<td>63</td>
</tr>
<tr>
<td>4.</td>
<td>Evaluation of the extent and degree of epidural anaesthesia in camels with the dose rate of 0.3 mg/kg body weight.</td>
<td>64</td>
</tr>
<tr>
<td>5.</td>
<td>Effect of epidural administration of xylazine on rectal temperature (°F) at different intervals clinical cases of camels.</td>
<td>68</td>
</tr>
<tr>
<td>6.</td>
<td>Effect of epidural administration of xylazine on respiration rate (per minute) at different intervals in clinical cases of camels.</td>
<td>71</td>
</tr>
</tbody>
</table>
7. Effect of epidural administration of xylazine on pulse rate (per minute) at different intervals in clinical cases of camels.

8. Number of animals and surgical affections treated under xylazine epidural anaesthesia in clinical cases of camels.

9. Effect of epidural administration of xylazine on haemoglobin (gm %) at different intervals in clinical cases of camels.

10. Effect of epidural administration of xylazine on packed cell volume (%) at different intervals in clinical cases of camels.

11. Effect of epidural administration of xylazine on total erythrocyte count (million/cumm) at different intervals in clinical cases of camels.

12. Effect of epidural administration of xylazine on total leucocyte count (thousand/cumm) at different intervals in clinical cases of camels.

13. Effect of epidural administration of xylazine on total serum protein (gm /100 ml) at different intervals in clinical cases of camels.
14. Effect of epidural administration of xylazine on serum glucose (mg/100 ml) at different intervals in clinical cases of camels.

15. Effect of epidural administration of xylazine on serum chloride (mEq/L) at different intervals in clinical cases of camels.

16. Effect of epidural administration of xylazine on serum sodium (mEq/L) at different intervals in clinical cases of camels.

17. Effect of epidural administration of xylazine on serum potassium (mEq/L) at different intervals in clinical cases of camels.
### List of Figures

<table>
<thead>
<tr>
<th>Fig. No.</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mean induction period</td>
<td>58</td>
</tr>
<tr>
<td>2.</td>
<td>Mean duration of anaesthesia</td>
<td>66</td>
</tr>
<tr>
<td>3.</td>
<td>Mean recovery period</td>
<td>67</td>
</tr>
<tr>
<td>4.</td>
<td>Rectal temperature</td>
<td>69</td>
</tr>
<tr>
<td>5.</td>
<td>Respiration rate</td>
<td>74</td>
</tr>
<tr>
<td>6.</td>
<td>Pulse rate</td>
<td>75</td>
</tr>
<tr>
<td>7.</td>
<td>Haemoglobin</td>
<td>80</td>
</tr>
<tr>
<td>8.</td>
<td>Packed cell volume</td>
<td>81</td>
</tr>
<tr>
<td>9.</td>
<td>Total erythrocyte count</td>
<td>82</td>
</tr>
<tr>
<td>10.</td>
<td>Total leucocyte count</td>
<td>86</td>
</tr>
<tr>
<td>11.</td>
<td>Total serum protein</td>
<td>87</td>
</tr>
<tr>
<td>12.</td>
<td>Serum glucose</td>
<td>91</td>
</tr>
<tr>
<td>13.</td>
<td>Serum chloride</td>
<td>92</td>
</tr>
<tr>
<td>14.</td>
<td>Serum sodium</td>
<td>96</td>
</tr>
<tr>
<td>15.</td>
<td>Serum potassium</td>
<td>97</td>
</tr>
</tbody>
</table>
INTRODUCTION
Indian one humped camel, the *Camelus-dromedarius*, is directly associated with rural economy and life of India's arid and semiarid zones including extensive western part of Rajasthan state in Thar desert. It is the most important source of power for agricultural, transportation, irrigation and communication operations in sandy areas where other animals and automobiles fail to operate. In general the camel is quite a sturdy animal. The climatic conditions of the desert are quite inimical to the spread of diseases. Owing to this fact the camel is less liable to suffer from the innumerable diseases from which the other livestock suffer. The significant position of the camel for ploughing and draughting purposes can't be ignored. Even in present era it is considered an indispensable draught animal for inhospitable desert terrain. It still remains a source of sustenance and accomplishment for the denizen of desert.

New anaesthetics are expected to come up at present and in future. Highly desired as prime additional qualification of newer anaesthetics is that they should not or minimal alter the physiological process other than their anaesthetic effects. This study is undertaken to evaluate merits of xylazine as an epidural anaesthetic in camels for surgical interventions.

Epidural anaesthesia in cattle was introduced by Benesch (1926). He described its advantages in obstetrical operations. Post-operative pain and abdominal pressure are reduced, resulted in easy obstetrical manipulation of foetus and its parts with no resistance. Suspended defecation helped in
maintaining clean and aseptic field. Epidural anaesthesia is entirely free from danger and the normal involution of the uterus was not interfered.

Ruminants are the most sensitive of the domestic animals to action of xylazine. In cattle, doses that produce deep sedation and analgesia are one-tenth those required in horses, dogs, and cats (Hopkins, 1972). Toxicity trials in cattle have shown that the LD50 of xylazine in adult cattle is three times the highest recommended dose of 0.3 mg/kg. According to Hopkins (1972), this is six times the dose rate indicated for majority of clinical cases. Ko et al. (1989) reported that systematically, epidural xylazine produces signs of sedation, salivation, vocalization, and bradycardia in bovines. Ataxia was also observed in the xylazine treated group which have been induced through a local and/or systemic effect.

Xylazine hydrochloride (Rompun, Bay Va 1470) was first synthesized in 1962. Pharmacologically, xylazine is classified as an analgesic as well as sedative. Xylazine also produces muscle relaxation by inhibition of intraneural transmission of impulses at the central level of the central nervous system. Xylazine is an alpha-2 adrenoceptor agonist and when given by epidural injection causes sensory blockade without motor effects. Therefore, their use in veterinary anaesthesia is appealing. Xylazine given epidurally produced greater perineal analgesia than did intramuscular. Higher dose of xylazine caused mild hind limb ataxia. LeBlanc et al. (1988) concluded that xylazine given by epidural injection resulted in safe and effective perineal analgesia.
Recently, xylazine has come up with the wide margin of therapeutic safety and the large varieties of its uses and unique properties. It is a sedative, anaesthetic, analgesic and muscle relaxant for use in veterinary practice. The active ingredients of xylazine is 2-(2,6-dimethyl phenylamino) 5,6-dihydro-4H-1,3-thiazine-hydrochloride which resembles tranquilizers in its activity. (Clarke and Hall, 1969). Xylazine has been administered successfully by intramuscular, subcutaneous and intravenous routes in various species. Local anaesthetic drugs frequently are used to induce epidural analgesia for a number of diagnostic and surgical procedures in animals. These drug depress axonal conduction. Sympathetic, sensory and motor fibers are affected in order of decreasing sensitivity. This nonspecific action may result in limb weakness when motor fibers are affected. Epidural analgesia by use of local anaesthetics in animal may induce marked ataxia or even recumbency as a result of depression of motor nerves in lumbosacral intumescence. It would be advantageous to use a drug for epidural analgesia that induces blockade of only sensory fibers without affecting autonomic or lower motor neurons.

Epidural administration of some adrenergic agents results in profound analgesia. This effect is mediated by spinal alpha2-adrenergic receptors, because the analgesia is antagonized by alpha2, but not alpha or beta-blockers. Alpha2 receptors inhibits the release of a spinal neurotransmitter (substance P) believed to be important in pain perception. Thus, inhibition of spinal transmission of painful stimuli is possible, using spinal or epidural alpha2 adrenergic agonists. The advantages of spinal alpha2 induced analgesia include
attenuation of supraspinal side effects, prolonged duration of action and absence of diminished hind limb strength. Xylazine is an alphag-adrenergic agonist commonly used parenterally for achieving sedation and analgesia in animals. Xylazine administered by epidural injection might result in caudal analgesia without extraspinal side effects (sedation, ataxia and cardiovascular depression), as suggested by LeBlanc et al. (1988).

Epidural injection of xylazine in cattle produced significantly greater duration of analgesia than did epidural lidocaine. Xylazine given epidurally, produced greater perineal analgesia than did xylazine intramuscular (Caron et al., 1989). Epidural administration of xylazine in buffaloes provided good local analgesia for successful completion of surgical intervention of tail and perineal regions. It was also found satisfactory for caesarean section as well as in the treatment of difficult after birth (Kumar et al., 1990).

Camel suffers from several surgical ailments of hind region involving hind-quarters, tail, bones, sheath, penis, vagina and perineum. Mortality and resultant economic losses may also occur due to these surgical ailments, if not treated in time. These can be corrected under epidural anaesthesia. The epidural administration of xylazine has not been reported previously in camels. In view of skimp information on this drug's epidural administration and lack of data on dosage in the available literature, it obviously became pertinent to make a study of epidural administration of xylazine for correcting surgical affections in camels with the following objectives.
1. To evaluate the dose and extent of epidural anaesthesia following administration of xylazine.

2. To study the duration, and degree of analgesia following administration of xylazine epidurally.

3. To study the clinical signs i.e. rectal temperature, respiration rate, pulse rate and ruminal motility before and after administration of xylazine epidurally.

4. To study the haematological and biochemical parameters before and after administration of xylazine epidurally.

5. To study the accidents during and after administration of xylazine epidurally, if any.

It is expected that the present study will be beneficial to the field Veterinarians for successful performance of various examinations and surgical procedures under xylazine epidural anaesthesia in the camel.
REVIEW OF LITERATURE
2. REVIEW OF LITERATURE

Xylazine is the British Veterinary codex approved non-proprietary name for 2-(2,6-dimethyl phenylamino)-4H-5,6-dihydro-1,3-thiazine, a compound first synthesized in 1962. Its structural formula is as under:

The information on the effects of epidurally administered xylazine is scanty in the available literature. However, substantial information is available on its effect after parenteral administration in various species. Therefore, some of the important results on that aspect have been included here for better understanding and comparison.

Pertinent literature has been reviewed under the following main heads.

2.1. Clinical observations.

2.2. Haematological observations.

2.3. Biochemical observations.
2.1 CLINICAL OBSERVATIONS

Epidural anaesthesia in cattle was introduced by Benesch (1926). He described its advantages in obstetrical operations. Post operative pain and abdominal pressure were reduced and this ensured easy obstetrical manipulation of foetus and its parts with no resistance. Suspended defecation helped in maintaining clean and aseptic field. Epidural anaesthesia was entirely free from danger and the normal involution of the uterus was not interfered.

Brook (1930) described some studies on epidural anaesthesia and its various aspects in different species of domestic animals. He found epidural anaesthesia most rapid in sheep and calf followed by ox, dog and cat and was slowest in horses. He described some disadvantages also, as some of the intervertebral foraminae of the spinal column were not closed sufficiently and the anaesthetic solution escaped through these foraminae without exerting any action on spinal nerves. In some fatty cattle, fat deposited in epidural space could block forward flow of anaesthetic solution. A case was also reported by him, in which, permanent paralysis of tail occurred following epidural injection for delivery of a dead and oedematous foetus in cow.

Weber (1942) considered that rapid anaesthesia obtained by injecting local anaesthetic agent at sacrococygeal space was due to forward slope of the sacrum, which allows the solution to quickly anaesthetize the nerves in this region.
Arthur (1956) described epidural anaesthesia as a unique single type of anaesthesia in cattle. It provided perfect anaesthesia and muscle relaxation and prevented defecation. So operations under epidural anaesthesia could be performed by a Veterinarian without any assistance.

Gibbons (1959) stated that epidural anaesthesia proved its excellent value in treatment of prolapse of vagina, rectum, uterus and in obstetrical procedures of cattle.

Clarke and Hall (1969) carried out experimental and preliminary clinical trials of xylazine in horses and cattle. They reported that the intramuscular injection of xylazine 2 to 3 mg/kg body weight, appeared to be a reliable, safe and short acting sedative for horses. Whereas, intravenous injection 0.05 to 0.1 mg/kg body weight or intramuscular injection 0.2 mg/kg body weight produced good basal narcosis lasting for one to two hours in cattle. They concluded that xylazine might prove to be a valuable sedative for horses and cattle.

Mangels (1969) evaluated the effects of xylazine in 155 healthy and sick cattle. Out of these, 62 animals receiving various dosages were observed for 24 hours and opined that sedation, anaesthesia and muscle relaxation were good and dose dependent.

Fessl (1970) carried out clinical trials in 146 horses, 61 cattle and three sheep with a sedative known as xylazine. He achieved good effect with 0.1 mg/kg body weight intramuscularly.
in cattle and 0.8 - 1.0 mg/kg body weight intravenously in horses. In both the species, the heart and respiratory rate were reduced by 30 to 40 percent and 20 to 25 percent, respectively. Whereas, the rectal temperature was elevated by 0.5 to 1.6°C. Except in one bull, the recovery was rapid and uneventful. The bull in which xylazine injection was repeated, remained down for about four hours after injection.

Hempel (1970) achieved adequate sedation, muscle relaxation and narcosis in 190 cattle within 10-12 minutes after intramuscular administration of xylazine. An initial dose of 0.5 mg/kg body weight and repeated doses to a total dose of 1.25 mg/kg body weight were used successfully for the prolonged operative procedure.

Lane (1970) reported that the Rompun (2% xylazine) was effective as a sedative in cattle when given intramuscularly. Author stated that no adverse reactions were encountered, although the Hereford bull showed prolonged recumbency and then depression lasting for more than a day.

Peczat and Borkowska (1970) used xylazine 0.05 to 0.2 mg/kg body weight intramuscularly in 14 healthy cattle. They claimed that the xylazine produced the best sedative, analgesic and relaxing effects at the dose rate of 0.1 mg/kg body weight without any side effects.

Ehmke and Bohn (1971) studied the use of xylazine as a premedicant followed by epidural analgesia in horses. The
Kylasine was administered 0.5-1.0 mg/kg body weight intravenously and the sedation commenced within 3-5 minutes after injection. They could not find any difference in efficacy of 2 and 10 percent concentration of xylazine.

Straub (1971) carried out xylazine anaesthesia in sheep. He observed maximum effects after 15 minutes of intramuscular xylazine administration 3.0 mg/kg body weight. This effect persisted for 45 minutes post-administration.

Hopkins (1972) reported the clinical pharmacology of xylazine in cattle. Xylazine was administered at the dose rate from 0.09 mg to 0.35 mg/kg body weight intramuscularly to 250 cattle. He reported the side effects following the administration of xylazine were (i) reduction in respiratory rate in all cattle but it was non-significant at these dose rates (ii) hyperthermia in all animals.

Fouad and Shokry (1973) evaluated chlorpromazine hydrochloride, proprionyl promazine and xylazine in 126 buffaloes of various age groups and body weight. Chlorpromazine hydrochloride and proprionyl promazine became effective in 30 minutes of injection providing sedation for about 4 hours. Xylazine became effective in 10 minutes after injection and produced sedation for 4-5 hours. Xylazine at a standard dose rate of 0.1 mg/kg body weight produced adequate sedation without loss of standing capacity. Xylazine appeared to be the most suitable preparation for sedation in buffaloes.
Hoffman (1974) evaluated xylazine as a chemical restraining agent, sedative and analgesic in horses. Xylazine was given in 223 horses intravenously 0.35-1.65 mg/kg body weight. He observed that the sedation and analgesia were good in 88 percent and excellent in 81 percent of the horses without adverse effects from single or repeated doses. Maximal sedation occurred in about 3 minutes and it lasted for about 30 to 40 minutes. Optimum dose for chemical restraint was observed to be 1.4 mg/kg body weight.

Mottelih and El-Gindhi (1975) studied tranquilizing effects of xylazine in 15 buffaloes. The clinical manifestations were recorded for different doses of drug. They observed that larger dose (0.1 and 0.15 mg/kg body weight) resulted in longer period of sedation causing recumbency, sleep, salivation, tympany, hyperthermia, and reduction in respiratory and pulse rate.

Kumar et al. (1976) administered xylazine with a 'Cap-chur' syringe at a dose ranging from 0.5 mg/kg to 1.7 mg/kg body weight for immobilization of 24 adult male buffaloes. They observed that the onset of inco-ordination varied from 5 to 9 minutes and sternal or lateral recumbency was achieved in 8 to 20 minutes. The animals recovered from the initial administration of the drug in 5-7 hours. There was a decrease in respiratory and heart rate and slight rise in rectal temperature after administration of xylazine. The effect of drug continued from 45 to 110 minutes. Pronounced salivation was observed in animals receiving higher dosages. However, the addition of
atropine sulphate reduced the degree of salivation. They concluded that xylazine was very well tolerated and can be used without any complications in buffaloes.

Kumar and Singh (1976) reported the use of xylazine as an immobilizing agent in cattle. Xylazine 0.1 mg/kg body weight given intramuscularly immobilized cattle in 8-10 minutes. Surgical operations varying from 22 to 70 minutes duration were performed under xylazine combined with either local infiltration anaesthesia or regional nerve block. The recovery was smooth and uncomplicated. The respiration and heart rates were reduced at maximum level of sedation.

Shokry et al. (1976) studied the effect of xylazine in sheep. Clinical signs, onset, and duration of sedation were recorded in 20 rams, administered xylazine 0.1 and 0.3 mg/kg body weight. They concluded that the xylazine was suitable for inducing the required sedation, analgesia and muscle relaxation in sheep without any side effects.

Custer et al. (1977) stated that the xylazine is a non-narcotic sedative and analgesic that is finding extensive use in the immobilization of ungulates. Its use as a sedative and pre-anaesthetic medication in dromedary camels has been described. They also observed that xylazine was found to be safe and reliable drug for chemical restraint of Bactrian camels. Dosage of 0.27 to 0.51 mg/kg body weight provided adequate sedation for the performance of various procedures (eg. Tuberculin testing, lymphnode biopsy, and electroejaculation). Rapid arousal from
the sedative effects of xylazine occurred after intravenous administration of doxapram hydrochloride in dosage of 0.05 to 0.13 mg/kg body weight.

Kumar and Singh (1977) studied the tranquilizing effect of xylazine administered intramuscularly at the dose rate of 0.22 mg/kg body weight in buffaloes. They observed that xylazine administration caused a significant decrease in respiration rate, heart rate and rectal temperature. The tranquilization was rated from good to excellent. No adverse reactions were encountered after administration and animal made an uneventful recovery.

Naegeli (1977) studied the respiratory and circulatory changes in cattle during casting by employing xylazine-metomidate and xylazine-thiopental. Seven cattle were cast, using xylazine-atropine pre-medication, followed by metomidate or thiopental. He found reduction in heart rate and respiration rate with xylazine-atropine pre-medication.

Kumar et al. (1979) reported that ketamine administration in dogs has been associated with lack of adequate muscle relaxation, convulsions rough emergence and excessive salivation. To overcome these side effects xylazine has been used in various species of animals. Administration of ketamine and xylazine intramuscularly produced excellent muscular relaxation and analgesia. The recovery in all the animals was smooth and uneventful.
They also stated that there was a decrease in respiratory rate and heart rate after xylazine and ketamine administration in dogs. The rectal temperature decreased in all the dogs, however, comparatively more decrease was observed in dogs undergoing surgery. The decrease in rectal temperature may be due to inhibition of skeletal muscle movements, reduction in metabolic rate or depression of thermoregulatory centre. A comparative greater decrease in animals undergoing surgery may be due to dissipation of heat from exposed viscera during surgery.

Kumar and Singh (1979) reported the use of ketamine and xylazine anaesthesia in bovine pediatric surgery. In their experiments in calves aged 15 days to 6 months, authors found that ketamine 11 mg/kg body weight intramuscularly preceded by xylazine 0.22 mg/kg body weight, intramuscularly produced good surgical anaesthesia lasting for about 40 to 55 minutes. Different surgical procedures on various body parts were carried out. They further added that there was slight reduction in respiratory rate, heart rate and rectal temperature during surgical anaesthesia. Recovery was smooth, quick and uncomplicated. They concluded that the combination of xylazine and ketamine was found satisfactory in bovine pediatric surgery.

Peshin and Kumar (1979) opined that in buffaloes, intramuscular administration of xylazine 0.22 mg/kg body weight, produced a significant reduction in heart rate and respiration rate (P<0.05) with slight reduction in rectal temperature. The values of above variables reached to pre-administration level in
150–180 minutes. Further, they observed that sedation and muscle relaxation remained for 60 minutes and complete recovery was achieved in 300 ± 18.33 to 344 ± 15.16 minutes.

Young (1979) studied the effect of xylazine on body temperature in three yearling calves. Intramuscular injection of xylazine 0.2 mg/kg body weight showed peak increase in body temperature to the extent of 1.6–1.9°C after 4–6 hours. Body temperature was still elevated after 12 hours and did not return to pre-administration values until 18 hours. During first hour after injection there was a sudden decrease in both heart rate and respiration rate.

Bolbol et al. (1980) studied 15 healthy dromedaries of different age, sex and weight which were sedated with 2% xylazine at an intramuscular dose of 0.25 mg/kg. Sedation began on an average, 13.4 minutes after injection, reached its maximum within 20.8 minutes and remained at this level for 55.9 minutes. Recovery took 115.8 minutes. Temperature, pulse, respiration returned to normal after 24 hours. They found that xylazine at 0.25 mg/kg body weight thus elicited excellent sedation with good muscle relaxation and was highly recommended.

Knight (1980) reported the muscle relaxant effect of xylazine is due to partial synaptic blockade in the CNS. This property of xylazine, and its duration of action, have useful application in relaxing and sedating ruminants with tetanus. In the United States, xylazine is approved only for use in horses, dogs, cats and certain wild animal species, but it is commonly
and effectively utilized in ruminants. Ruminants are the most sensitive to the effect of xylazine, requiring about one-tenth the dose to produce the equivalent state of sedation in horses, dogs and cats. Also because of its oxytocin like effect on the uterus, xylazine should not be used in ruminants in late pregnancy because it may cause abortion.

Peshin et al. (1980) reported intramuscular administration of xylazine at the rate 3 mg/kg body weight in dogs produced muscle relaxation, this muscle relaxant effect of xylazine has been reported due to suppression of the intraneural transmission of impulses and not probably due to paralysis of neuromuscular transmission.

Peshin et al. (1980) studied on xylazine given intramuscular to 12 apparently healthy adult camels at the rate of 0.4 mg/kg body weight, mean values for onset of weak time, down time, and until recovery were 8.6 ± 1.1, 10.5 ± 0.6 and 150 ± 56.9 minutes, respectively. Mild salivation, drooping of lower lip and relaxation of neck were observed at mean times of 15.3 ± 4.9, 11.9 ± 1.7 and 22.7 ± 3.9 minutes, respectively. Analgesic effects remained for 60 to 90 minutes. When xylazine was used at the same dosage in 13 clinical cases involving surgery of short duration, it proved to be satisfactory sedative, analgesic and muscle relaxant.

Aouad et al. (1981) evaluated anaesthesia achieved by ketamine and xylazine in calves. Intravenous administration of ketamine 11 mg/kg body weight, had very little effect on heart
rate, respiratory rate and body temperature. Whereas, intramuscular administration of xylazine 0.28 mg/kg body weight, caused a brief initial rise in blood pressure, followed by a decrease in respiratory rate, blood pressure and oxygen tension. A combination of ketamine – xylazine 2.85 mg/kg body weight and 0.14 mg/kg body weight, respectively resulted in an initial rise in heart rate, respiratory rate and blood pressure. Finally, they concluded that this low dose combination was effective in producing anaesthesia.

Waterman (1981) evaluated the effect of xylazine and ketamine hydrochloride combination in calves. Thirty calves were anaesthetized with ketamine 5 mg/kg body weight intravenously or 10 mg/kg body weight intramuscularly. In both the groups xylazine was given intramuscularly 0.2 mg/kg body weight to improve muscle relaxation. Ketamine was given either 10 minutes after xylazine or simultaneously. They found that the initial fall in respiratory and pulse rate after xylazine administration was followed by rise in these values after injection of ketamine. Muscle relaxation was of good quality and recovery in all cases was smooth.

Mbiuki (1982) employed xylazine and ketamine anaesthesia in 24 cattle. Xylazine was given either intramuscularly or intravenously 0.1 mg/kg body weight. Whereas, ketamine was given 6 mg/kg body weight intramuscularly and 2 mg/kg body weight intravenously. He observed that the duration of anaesthesia varied with the route of drug administration and the part of the body tested for anaesthesia. Mean recovery time
ranged from 30.8 to 63.0 minutes. Duration of analgesia ranged from a mean of 8.3 minutes at the coronet to a mean of 66.0 minutes at the paralumbar fossa. Heart rate remained within normal limit but rectal temperature and respiration rate varied. Further, he recorded increased salivation and retained swallowing reflexes in few animals.

Tantawy et al. (1982) studied the clinical effect of xylazine in buffaloes. Xylazine was injected intramuscularly 0.02, 0.03, 0.05 or 0.07 mg/kg body weight. The dose of xylazine 0.03 mg/kg body weight was found to be most effective. With this dose the animal became docile after 15 minutes and could be examined easily for 85 minutes. Body temperature was increased after injection, while pulse rate, respiration rate and ruminal movements were decreased.

Singh et al. (1983) reported a case of retention of urine in male camel due to urethritis. They observed high percentage of blood urea nitrogen (175 mg percent) and creatinine concentrations. Blood gas analysis showed development of metabolic alkalosis. Administration of xylazine to achieve analgesia for surgery, increased the metabolic alkalosis and also caused respiratory acidosis.

Singh et al. (1983) reported that after xylazine administration intravenously (0.22 mg/kg) to six cross-bred calves, mean values of rectal temperature, haemoglobin and heart rate were not affected.
Higgins and Kock (1984) recommended administration of 10% xylazine solution (Rompun, Bayer) as a sedative of choice by intramuscular or intravenous route. The onset of sedation was found to be 12 to 15 minutes with intramuscular injections characterized by relaxation of lower lip and closure of eyelids. The recovery from xylazine sedation was found to be quiet. The xylazine premedication was recommended at a dose rate of 0.25 to 2 mg/kg body weight depending upon the nature of general anaesthetic chosen.

Peshin et al. (1986) studied the acid-base and blood gas changes following intramuscular administration of xylazine 0.22 mg/kg body weight in six buffalo calves. They observed metabolic alkalosis and significant reduction in respiration rate.

Saikia and Pathak (1987) reported that xylazine has been used as a sedative for restraining of a Royal Bengal tiger for management of multiple injuries for that, xylazine hydrochloride was injected 1.1 mg/kg body weight (total dose 110 mg) into the tail muscle at the level of the third coccygeal vertebra. They found that the onset of effect was 15 minutes after injection. The initial effect was characterized by reduced alertness, restriction of movement of the tail and drooping of the head and increased salivation. They concluded that muscular relaxation and analgesia were excellent with xylazine.

White et al. (1987) studied the effect of either xylazine (0.25 mg/kg) intramuscularly, ketamine (5.5 mg/kg) intramuscu-
larly or a mixture of xylazine (0.15 mg/kg) and ketamine (2.5 mg/kg) intramuscularly on sedation, analgesia, cardiac and respiratory rates, body temperature and muscle relaxation in the domesticated dromedary. They observed that either drug used separately was suitable for sedation and analgesia, but the mixture of xylazine and ketamine was superior to either drug used alone. Camels which received the combination of xylazine and ketamine had fewer effects on cardiac and respiratory rates and better analgesia. In addition, they showed better muscle relaxation, less central nervous irritability and shorter recovery times than camels sedated with ketamine alone.

LeBlanc et al. (1988) reported the use of xylazine by epidural route in horses for perineal analgesia. They studied the effectiveness of xylazine hydrochloride, an alpha2 agonist commonly used in horses. Xylazine, 0.9 percent NaCl and lidocaine were given by epidural injection to horses subjected perineal electrical stimulation. Administration of xylazine 0.17 mg/kg body weight (diluted to a 10 ml volume using 0.9 percent NaCl) induced approximately 2.5 hours of local analgesia without apparent side effects. Higher dose (0.36 and 0.41 mg/kg body weight) of xylazine caused mild hind limb ataxia. Administration of lidocaine induced a similar duration of analgesia with severe hind limb ataxia. They concluded that xylazine given by epidural injection resulted in safe and effective perineal analgesia in horses.

Ali et al. (1989) studied on six healthy dromedaries with propionyl promazine, xylazine, acepromazine or chlorpromazine at
single intramuscular doses of 0.5, 0.25, 0.1 or 3 mg/kg, respectively, the onset, duration and degree of sedation produced by each drug were assessed for six hours. The onset and duration of action were 10 minutes and 2.1 ± 0.5 hours for propanol promazine, 4 minutes and 3.1 ± 0.4 hours for xylazine, 5 minutes and 2.3 ± 0.5 hours for acepromazine, and 7 minutes and 2.5 ± 0.4 hours for chlorpromazine. Xylazine seemed to be superior to the other three drugs in producing sedation. No significant effect on rectal temperature or respiration rate was seen.

Bonath et al. (1989) reported that tolazoline injected intravenous at 40-67 mg/100 kg body weight enabled camels immobilized with xylazine to stand about 12 minutes, compared with a hour or more without xylazine.

Caron and LeBlanc (1989) performed caudal epidural analgesia in cattle using xylazine. The cows were given a single 5 ml epidural injection of one of four different concentrations of xylazine. The dose that produced the longest duration of analgesia and the least ataxia or sedation was approximately 0.05 mg/kg body weight. The analgesia produced by xylazine dose (25 mg/5 ml) was compared to standard dose of epidural lidocaine (100 mg/5 ml) by the same method. To investigate the role of systemic absorption in the production of epidural analgesia, the previously utilized epidural xylazine dosage was given intramuscularly in four adult cows. The results of parenteral administration were compared to that of epidural administration. They concluded that xylazine produced
greater perineal analgesia than did epidural lidocaine or xylazine intramuscularly.

Fayed et al. (1989) evaluated the effect of xylazine in heifers under thermoneutral or heat stress conditions. They studied the effect on pulse rate, respiration rate and rectal temperature and concluded that xylazine has no effect on body temperature and respiration rate in heifers under the thermoneutral condition (18°C, 42 percent humidity) while pulse rate was slightly decreased.

Fikes et al. (1989) reported that xylazine (0.35 mg/kg) or lidocaine (0.35 mg/kg) was injected into epidural space of six ponies to compare their effectiveness as epidural analgesics. Each pony received both treatments at one week intervals with the order of treatments randomized. Xylazine produced analgesia of significantly longer duration (247 ± 58 minutes) than that produced by an equal dose of lidocaine (135 ± 22 minutes).

Ko et al. (1989) evaluated and compared the effect of caudal epidural administration of xylazine or lidocaine on uterine motility and perineal analgesia in cow. They administered 2 percent lidocaine 0.2 mg/kg body weight and xylazine 0.06 mg/kg (diluted in 5 ml saline) body weight. They observed that xylazine produced a higher degree and longer duration of perineal analgesia than lidocaine. Ataxia was also observed in the xylazine treated group might have been induced through local and systemic effect.
Tanwar et al. (1989) reported the epidural anaesthesia in camels. The anatomical site for epidural injection was found to be the sacro-coccygeal space. The varying doses of 2% procaine hydrochloride were administered epidurally to record signs, extent, duration and recovery periods of anaesthesia. In clinical trials, the effect of 2% xylocaine was rated as superior with longer recovery period over 2% procaine hydrochloride.

Jean et al. (1990) evaluated epidurally administered xylazine 0.05 mg/kg body weight in 8 cows. It induced sedation and selective (S3 to Co.) analgesia for at least 2 hours. Mild ataxia was observed in 6 cows, but all cows remained standing. Heart rate, respiration rate, ruminal contraction and arterial blood pressure were significantly (P<0.05) decreased. Rectal temperature was significantly increased 120 minutes post-administration. They concluded that the cardiopulmonary depressant effect was tolerated in healthy cows, but could be detrimental in cows with cardiopulmonary diseases.

Kumar et al. (1990) reported the use of xylazine 0.1 to 0.2 mg/kg body weight administered epidurally in buffaloes. According to them it has a local as well as generalised effects. The sedation/analgesia produced by epidural xylazine simulated the effect of its parenteral administration. Xylazine administered 0.1 mg/kg body weight produced mild to good sedation lasting for about 40-45 minutes, which was character-
ized by calming effect, pendulous lower lip, inclination of head and sleepiness. A significant decrease in respiration and heart rate was observed during sedation. Xylazine administered epidurally 0.2 mg/kg body weight produced sternal recumbency, salivation, excellent sedation and no response to pin prick stimulation at the perineal and caudal region. The recovery from sedation was good in all the animals. It provided good local analgesia for performing surgery in tail and perineal region as well as for caesarean section and difficult after birth.

LeBlanc and Caron (1990) studied the clinical use of epidural xylazine in the horse. They administered xylazine into the epidural space of 9 horses to facilitate various perineal manipulations (Rectovaginal laceration repair, replacement of prolapsed rectum and urethral extension). The resulting caudal analgesia was sufficient for all procedures. The duration of analgesia from single injection of epidural xylazine (0.17 to 0.22 mg/kg body weight) was at least 3.5 hours. No horse was ataxic during or after the treatment. The trial demonstrates that xylazine given into the epidural space of horses provides prolonged regional analgesia which is sufficient for clinical use.

LeBlanc and Eberhart (1990) studied the cardiopulmonary effects epidurally administered xylazine in the horses. They administered xylazine 0.17 mg/kg body weight epidurally, and
intravenously, lidocaine 0.45 mg/kg body weight epidurally and 10 ml saline epidurally in each horse (in a random design). The heart rate, respiration rate, mean arterial blood pressure and arterial blood gas values did not differ significantly between treatment or within each treatment over the time interval. A short period (X=15 minutes) of mild sedation was observed after the intravenous administration of xylazine but that was not sufficient to prevent and avoid response to pin prick of the perineal area. Sedation was not observed in horses treated by xylazine, lidocaine or saline administered epidurally. Epidural administration of lidocaine and xylazine prevented an avoidance response to pin prick of perineal area. Saline administered in the caudal epidural space did not desensitize the perineal region.

Robertson et al. (1990) evaluated the effect of xylazine hydrochloride on rectal temperature in neonatal foals. They observed significant fall in rectal temperature at 30 to 120 minutes post-administration. However, hypothermia was not found in the saline treated control group.

Skarda et al. (1990) observed the influence of tolazoline on caudal epidural administration of xylazine in cattle. A 2X solution of xylazine-HCl was injected into the epidural space at the first coccygeal interspace, using a dosage of 0.05 mg/kg body weight, diluted to a 5 ml volume with sterile water and administered at a rate of approximately 1 ml/30 second in
eight cattle. Eight minutes after xylazine injection, either
tolazoline, (0.3 mg/kg), and alpha₂-adrenoceptor antagonist, or
saline solution (4 ml) was administered intravenously. All
eight cattle were treated, using both regimens in a random
sequence, at least one week elapsed between treatment.
Epidurally administered xylazine induced caudal analgesia (S₃ to
Co.), as evaluated by no response to superficial and deep
muscular pinprick and inhibition of rumen motility, but all
cattle remained standing. Tolazoline effectively reversed
xylazine induced cardiopulmonary depression without affecting
sedation and desirable local (S₃ to Co.) analgesic effects.

Zaugg and Nussabaum (1990) administered xylazine 0.07
mg/kg body weight epidurally and achieved anaesthesia lasting on
an average of 90 minutes with desensitization at least up to 10th
thoracic vertebrae. They concluded that the epidural route of
xylazine administration was an effective alternative for pain
relief during surgery cranial to the perineal region and it
allowed patient to remain standing.

Patel. (1991) evaluated the effect of intramuscular
administration of xylazine in calves 0.1 mg, 0.2 mg, and 0.3
mg/kg body weight. The dose between the range of 0.2 and 0.3
mg/kg body weight may prove much better than the either one.
Xylazine produced optimum analgesia, sedation, muscle relaxation
and marked salivation. There was no involuntary movements
during induction. There was decrease in respiration rate, heart
rate and rectal temperature which got compensated by four hours after administration.

Reddy et al. (1991) reported the use of xylazine in cattle. Thirty apparently healthy cross-bred bull calves were used in its experiment. These calves were randomly divided into five groups of six calves each and were administered intramuscularly 2% xylazine solution at the dose rate of 0.4 mg/kg, 0.3 mg/kg, 0.2 mg/kg, 0.1 mg/kg and 0.05 mg/kg body weight, respectively.

They observed that time taken for the onset of sedation ranged from 7.83 min. at 0.4 mg/kg body weight to 12.23 min. at 0.05 mg/kg body weight dosage level. The maximum duration of sedation recorded was 295 min. at 0.3 mg/kg body weight. The recovery time of 304.83 min. was recorded with the dose of 0.3 mg/kg body weight and 95 min. with 0.05 mg/kg body weight. The results in the present study indicated that intramuscular administration of xylazine at the dose rate of 0.2 mg/kg body weight produced sedation which will be suitable for major surgical operations in cattle. Following administration of xylazine at different dosage levels, the rectal temperature did not show significant variation and there was a significant decrease in respiratory rate post-administration period when compared with pre-administration levels.
Dioli et al. (1992) advocated administration of xylazine at the dose rate of 0.2 to 0.5 mg/kg body weight intramuscularly causing sedation for 30-60 minutes whereas, 0.1 to 0.2 mg/kg body weight intramuscularly led to anaesthesia for 90 minutes. The onset of the effect of xylazine administration was reported to be 15 minutes and was characterized by a pendulous lower lip, closed eye-lids, increased salivation and bradycardia. Atropine sulphate at a dose of 0.01 to 0.02 mg/kg body weight, intravenously to counteract the bradycardia and increased salivation. Whereas, doxapram-HCl at a dose rate of 0.05 to 0.13 mg/kg body weight intravenously was recommended to hasten arousal and counteract respiratory problems. Yohimbine at a dose rate 0.125-0.25 mg/kg body weight intramuscular was recommended as antidote to the xylazine.

Fowler (1992) reported administration of xylazine at a dose rate of 0.1 to 0.2 mg/kg, intravenous for sedation and 0.25 mg/kg, intravenous for immobilization. However, it was not recommended for anaesthesia due to its poor analgesic effect. Similar findings were observed by Dioli et al. (1992) for xylazine administration in camels.

Gahlot and Chouhan (1992) described administration of epidural anaesthesia at sacro-coccygeal space using 30 to 50 ml of 2% lignocaine-HCl in camels. The duration of analgesia was 40-60 minutes and recovery period was 2-4 hours. Whereas, duration of analgesia was 75-120 minutes with 100-150 ml of
lignocaine. The anaesthesia was indicated for castration, tail
docking, surgery for soft-tissues and orthopedic affections of
hind-quarter, prolapse of vagina and rectum, prolapse of sheath
and perineal abscesses or gangrene and to minimise the
struggling during operations performed in lateral recumbency.

Grubb et al. (1992) reported the evaluation of
lido-caine-xylazine for epidural anaesthesia in horses. They
found that lidocaine is commonly used for epidural anaesthesia
in horses but its duration of action was short and ataxia was
common. They also found that xylazine is used for epidural
anaesthesia because of its longer duration of analgesia and
decreased incidence of ataxia. However, onset of analgesia is
prolonged.

Xylazine (0.17 mg/kg diluted with sterile water to 6
ml/454 kg ), lidocaine ( 0.22 mg/kg ) and a combination of
xylazine ( 0.17 mg/kg ) and lidocaine ( 0.22 mg/kg ) were
administered through indwelling epidural catheter at weekly
intervals in a latin square design to six healthy adult horses
weighing 352-482 kg. They observed time to onset of analgesia
was not different between lidocaine ( 4.3 ± 0.8 min. ) and
lidocaine/xylazine (5.3 ± 1.1 min. ) but both groups were
faster (P<0.05) than xylazine (32.0 ± 3.4 min. ). Duration
of analgesia was different (P<0.05) among all groups
(lidocaine/xylazine, 329.8 ± 6.2 : lidocaine 87.2 ± 7.5 : and
xylazine, 204.2 ± 12.9 min. ). Ataxia occurred in 4 of 6 horses.
given lidocaine alone and in 2 of 6 horses given lidocaine/xylazine but all horses remained standing. Results indicated that lidocaine/xylazine provides rapid onset and prolonged duration of epidural analgesia in horses without producing sedation. They also reported that there was significant effect on pulse or respiration rates and no horse showed sign of sedation, when they administered xylazine (0.17 mg/kg) epidurally in horses.

Ko et al. (1992) studied the effects of lumbo-sacral epidural injection of detomidine or xylazine in swine. They administered either detomidine (500 μg/kg in 5 ml saline) or xylazine (2 mg/kg in 5 ml saline) in six mixed-breed female pigs on two occasions at one week intervals. At 60 minutes post-treatment, 200 μg/kg atipamezole (alpha2 anta-gonist) was administered intravenously and data collection was continued for an additional 60 minutes. Xylazine induced surgical analgesia caudal to the umbilicus for 120 minutes whereas detomidine induced minimal analgesia in the same region. Xylazine and detomidine induced signs of sedation and immobilization. Atipamezole reversed detomidine induced analgesia, sedation, and immobilization. In contrast, atipamezole reversed xylazine induced sedation, but not analgesia or immobilization. They concluded that in swine, xylazine had its sedative effect, local analgesic properties that were not mediated by alpha2 adrenoceptors in the spinal cord.
Riebold et al. (1992) reported to determine the efficacy of lidocaine and xylazine for epidural anaesthesia in cattle. Caudal epidural anaesthesia was obtained in nine dairy cows ranging in weight from 520 to 613 kg with 2% lidocaine (0.22 mg/kg), 2% xylazine (0.05 mg/kg), and lidocaine (0.22 mg/kg)—xylazine (0.05 mg/kg) at no earlier than biweekly intervals. They observed time to onset was 4.8 ± 1.0 min. and duration of action was 81.8 ± 11.8 min. for the lidocaine group. Time to onset and duration of action were 11.7 ± 1.0 min. and 252.9 ± 18.9 min., respectively, for the xylazine group. Time to onset and duration of action were 5.1 ± 0.9 min. and 302.8 ± 11.0 min., respectively, for the lidocaine—xylazine group. No significant difference was obtained in onset of anaesthesia following lidocaine or lidocaine—xylazine. Onset of anaesthesia was slower following xylazine when compared to the other treatments. Duration of anaesthesia was significantly different for all groups. All cattle became sedated but remained standing and were analgesic to T₁₃ following epidural xylazine. They concluded that the combination of drugs produces analgesia of quicker onset than xylazine and of longer duration than either agent given alone.

Ameerjan (1993) reported the experimental study on 36 apparently healthy bull calves. The experimental animals were randomly divided into three groups of 12 animals each. In Group-I, xylazine was administered intramuscularly (0.2 mg/kg); in Group-II, ketamine was administered intravenously (5 mg/kg).
and in Group-III, xylazine was administered intramuscularly (0.2 mg/kg), prior to the intravenous administration of ketamine (2 mg/kg). The induction time was found to be shortest among the calves of Group-III (2.0 ± 0.07 min.) followed by Group-II (2.13 ± 0.13 min.) and Group-I (12.02 ± 0.62 min.). It was also observed that xylazine produced analgesia lasting 20.83 ± 5.46 min. Recovery was noticed to be quickest in the ketamine administered group (1.45 ± 0.02 min.) followed by the ketamine-xylazine combination group (7.85 ± 0.95 min.) and xylazine group (16.46 ± 1.23 min.).

Balakishan (1993) studied the effects of epidural administration of xylazine and lignocaine hydrochloride in six apparently healthy buffalo calves. Caudal epidural analgesia was obtained with 2% xylazine (0.05 mg/kg and 0.07 mg/kg) and 2% lignocaine hydrochloride (0.05 ml/kg) given into first intercoccygeal space. Time to onset and duration of action were 20.3 ± 1.0 min. and 128.5 ± 3.7 min., respectively with xylazine (0.05 mg/kg). No animal showed symptoms of ataxia. Perfect analgesia was observed throughout the surgical procedure done in standing position. Xylazine at the dose rate of 0.07 mg/kg caused ataxia in all the calves.

Time to onset and duration of action were 6.3 ± 0.8 min. and 73.8 ± 8.4 min., respectively with lignocaine hydrochloride. All the calves showed severe ataxia and were recumbent within 20 minutes. No systemic effects were seen with lignocaine.
hydrochloride. Onset of analgesia was slower and duration of action was longer with xylazine when compared to lignocaine hydrochloride. Anatomical extent of analgesia was same with both groups (S3 to Co.). It was concluded that xylazine produces prolonged analgesia and sedation with better maintenance of hind limbs strength than lignocaine hydrochloride. He also observed that there was decrease in heart rate, pulse rate, respiratory rate ruminal contractions and increase in temperature after epidural administration of xylazine.

Singh et al. (1993) reported the clinical use of detomidine in buffalo and camel. Detomidine was used for sedating 46 female adult buffaloes (300-600 kg) and 6 male camels (250-500 kg). Three buffaloes were pregnant between 3 to 6 months. The dose ranged from 20 to 60 µg/kg and 30 to 60 µg/kg for buffaloes and camels, respectively. The drug was administered either intravenously or intramuscularly.

They observed that the induction time and duration of sedation in buffaloes and camels ranged from 2 to 25 min., 3-18 min. and 40-80 min., 30-45 min., with the dose of detomidine ranged 20-60 µg/kg and 30-60 µg/kg, respectively. Mild to moderate ataxia of 6 to 30 min. duration and salivation were observed in most animals. No adverse effect was seen in pregnant buffaloes. In all the camels, "good" sedation developed. Drooping of the lower lip, relaxation of the neck, salivation and ataxia were common features.
2.2 HAEMATOLOGICAL OBSERVATIONS

Goranov et al. (1971) reported experimental and clinical study on the action of xylazine in cattle. They observed that haematological changes (lower haemoglobin concentration and erythrocyte count, faster blood sedimentation rate, change in leucocyte picture) were most pronounced during three hours after injection but these values returned to normal by 24 hours.

Foaud and Shokry (1973) carried out comparative studies of chlorpromazine hydrochloride, propionylpromazine and xylazine in buffaloes. They observed that all the three drugs caused erythropenia of around 17 percent, significant reduction of haemoglobin levels and leucopenia of around 15 percent. But, these values returned to normal within 24 hours after administration.

Presidente et al. (1973) studied the effect of etorphine and xylazine combination in captive white tailed deer. They found significant decrease in erythrocyte count, packed cell volume and haemoglobin concentration in fawns approximately 39 minutes after injection whereas leucocyte count remained unchanged.

Drevemo et al. (1974) studied the effect of xylazine and xylazine-etrophine, acepromazine combination on haematological parameters in impala and eland. They observed decrease in
number of erythrocytes, leucocytes, haemoglobin value and packed cell volume.

Kral et al. (1974) reported xylazine and ketamine hydrochloride anaesthesia in cats. They found decrease in erythrocyte and leucocyte count.

Mottelib and El-Gindhi (1975) evaluated clinical and haematological effects of xylazine in buffaloes at different dosage levels. They observed a pronounced decrease in erythrocytes, leucocytes and haemoglobin content half an hour after injection. The percentage of lymphocytes and eosinophils were decreased, while that of neutrophils were increased with a slight shift to the left.

Kumar and Singh (1976) reported the use of xylazine as an immobilizing agent in cattle by intramuscular administration. They observed significant reduction in the values of total erythrocytes (from 6.72 ± 0.64 to 6.01 ± 1.02 million per cmm), leucocytes (from 8.24 ± 1.97 to 7.82 ± 2.61 thousand per cmm), haemoglobin concentration (from 10.54 ± 0.98 to 8.94 ± 1.62 gm%) and packed cell volume (from 34.20 ± 1.92 to 31.64 ± 2.54 percent) at peak sedation. Neutrophilia with corresponding lymphocytopenia was also observed. However, they concluded that the effects on haematological parameters were transient in nature and compensated within 24-72 hours of administration.
Custer et al. (1977) studied the haematologic and serum biochemical values for camels restrained manually and were compared with those camels restrained with xylazine. Xylazine treated camels had significantly lower values for red blood cells, haemoglobin and packed cell volume. They concluded that an actual decrease in R.B.C numbers may have been the result of selective sequestration by organs such as the spleen.

Eichner et al. (1979) evaluated the effect of intravenous administration of xylazine in beef cattle. They observed 20 percent decrease in haemoglobin percentage, red blood cells and packed cell volume.

Kumar et al. (1979) stated that the changes in haematocytologic parameters included a slight decrease in total erythrocytes, leucocytes, haemoglobin concentration and packed cell volume 45 minutes after ketamine and xylazine administration intramuscularly in dogs.

Kumar and Singh (1979) observed transient changes in erythrocytes (from 5.08 ± 0.42 to 4.50 ± 0.36 million per cmm), leucocytes (from 10.12 ± 0.30 to 9.06 ± 0.28 thousand per cmm), haemoglobin (from 9.55 ± 0.42 to 8.22 ± 0.36 gm percent), PCV (from 26.80 ± 0.42 to 25.06 ± 0.52 percent) and differential leucocyte count after ketamine and xylazine anaesthesia in bovine pediatric. But these changes were compensated in 48 hours.
Bolbol et al. (1980) observed the effect of xylazine on blood values in dromedaries which included significant reduction in total erythrocytes and leucocytes, haemoglobin content and haematocrit. All these values returned to normal after 24 hours.

Peshin et al. (1980) observed haematologic changes which included a slight decrease in total erythrocyte and leucocyte count, packed cell volume and haemoglobin concentration after administration of xylazine intramuscularly in dogs.

Peshin et al. (1980) reported that haematologic changes were not statistically significant, when xylazine was administered intramuscularly to camels.

Peshin and Kumar (1983) studied the effect of xylazine in buffalo. They reported a slight decrease in erythrocyte and leucocyte count (from 5.97 ± 1.12 to 5.24 ± 0.76 million per cmm and 10.61 ± 8.81 to 9.67 ± 1.34 thousand per cmm, respectively), packed cell volume (from 27.60 ± 3.11 to 26.30 ± 3.59 percent) and haemoglobin concentration (from 9.40 ± 0.79 to 9.00 ± 0.64 gm percent) after xylazine administration which denoted dilution of blood.

Cross et al. (1988) studied the effect of physical restraint and xylazine sedation on haematological values in red deer. They found transient significant reduction in the haematological values in the xylazine treated groups.
Ali et al. (1989) studied the effect of xylazine administered intramuscularly in six healthy dromedaries. There were consistent, but significant decreases (about 10%) in the haemoglobin concentration and erythrocyte counts one hour after treatment.

Reddy et al. (1991) studied the use of xylazine in cattle administered intramuscularly at the dose rates of 0.4, 0.3, 0.2, 0.1 and 0.05 mg/kg body weight. They reported that there was a fall in PCV following administration of xylazine at 0.4 mg/kg body weight from 1 hour to 4 hours post-administration period. At 0.3 mg/kg body weight the fall was significant from 1 to 8 hours, at 0.2 mg/kg body weight upto 4 hours and at 0.1 mg/kg and 0.05 mg/kg body weight, the change in PCV was not significant. The WBC count was significantly lower 1 hour after administration of 0.4 mg/kg, 0.3 mg/kg, 0.2 mg/kg and 0.1 mg/kg doses. Other dosage levels did not show any significant variation in WBC count. The decrease in RBC count was significant at 1 hour post-administration at 0.4 mg/kg, 0.3 mg/kg, 0.2 mg/kg, while with 0.1 mg/kg dose the significant decrease in RBC count was noticed upto 2 hours of post-administration period.

Shah (1991) studied the effect of xylazine administered intramuscularly in calves. There was significant reduction in total erythrocyte count, total leucocyte count, packed cell volume, and haemoglobin concentration. The changes were more marked upto 2 hours after administration which reduced in its
intensity from 2 to 4 hours and reached to near normal level 24 hours post-administration.

More et al. (1993) studied on evaluation of diazepam-xylazine-ketamine anaesthesia which was undertaken in 12 cow calves of 6-12 months of age and had a body weight 40-70 kg. Diazepam was administered intramuscularly @ 0.25 mg/kg body weight 15 minutes prior to xylazine-ketamine mixture. Ketamine was administered intravenously @ 1.2 and 3 mg/kg body weight in combination with xylazine (0.04 mg/kg) in group I,II and III, respectively. They found that the haematological changes included a slight reduction in TEC,Hb and significant decrease in TLC and PCV at maximum depth of anaesthesia.

2.3 BIOCHEMICAL OBSERVATIONS

The anaesthetics when injected into the body are mainly detoxified by the liver and excreted through kidneys. Preservation of liver and renal function is an important criteria for safety of any anaesthetic agent used. During detoxification process these anaesthetics may cause reversible or irreversible damage to the liver and kidney parenchyma.

Goranov et al. (1971) administered xylazine intramuscularly at the dose rate of 0.05, 0.1 and 0.2 mg/kg body weight in cattle. They found rise in blood sugar level from 49.5 to 158.2 mg percent by 1-3 hours after injection.
Short et al. (1972) observed significant increase in glucose level ranging from 63.5 mg to 118.8 mg percent two hours after the administration of xylazine in horses.

Kumar and Singh (1976) observed in their experiments with xylazine in cattle that there was a rise in blood glucose level (from 58.65 ± 7.62 to 88.60 ± 11.52 mg percent) which lasted for about 48 hours.

Shokry et al. (1976) found significant increase in blood glucose following xylazine administration in sheep.

Symonds (1976) noticed hyperglycaemia in two cows after xylazine administration with a maximum level of 200 mg percent at 40 minutes post-administration. The high level of glucose persisted up to 185 minutes and got compensated by 24 hours post-administration.

Custer et al. (1977) found significantly higher blood glucose concentration following xylazine administration in Bactrians camels.

Symonds et al. (1978) studied the effect of xylazine alone and in combination with insulin on blood glucose and insulin level in dairy cows. They reported that the xylazine 0.18 mg/kg body weight given intramuscularly or 0.15 mg/kg body weight given intravenously caused an increased in hepatic glucose production and decrease in plasma
insulin concentration up to 25 to 33 percent of control values. When 200 units of soluble insulin were given 20 minutes after similar doses of xylazine, there was a rapid fall in blood glucose and reduction in the rate of glucose production.

Thurmon et al. (1978) reported that when xylazine was given 0.22 mg/kg body weight or 0.44 mg/kg body weight in cattle, the glucose could be detected in the urine of these animals at 15 to 30 minutes post-administration. They observed maximum level at two hours and when it was undetectable at 5-6 hours.

Eichner et al. (1979) observed hyperglycaemia in beef cattle within 15 minutes of xylazine administration at the dose rate of 0.2 mg/kg body weight. The values were 195.00 ± 15.00 mg percent and 305.00 ± 10.00 mg percent at 15 minutes and 3 hours, respectively.

Kumar et al. (1979) observed that blood glucose was elevated in dogs when xylazine and ketamine was administered intramuscularly.

Kumar and Singh (1979) employed ketamine and xylazine anaesthesia in bovine pediatric and found transient rise in glucose values (from 81.58 ± 2.78 to 89.82 ± 1.92 mg/100ml) which compensated by 48 hours post-administration.
Knight (1980) observed that xylazine produces a pronounced and persistent hyperglycaemia (as long as 24 hours in ruminants) by increasing hepatic glucose production and decreasing plasma insulin levels. They also reported that xylazine is possibly contra-indicated in animals with urethral obstruction because it causes hyperglycaemia and resultant osmotic diuresis which could result in rupture of an already distended urinary bladder.

Peshin et al. (1980) observed that marked hyperglycaemia was at 30 minutes after the administration of xylazine intramuscularly to camels.

Peshin et al. (1980) observed a significant increase in blood glucose level after the administration of xylazine intramuscularly in dogs.

Broachman (1981) studied the effect of xylazine on plasma glucose in sheep. He found that xylazine was known to cause hyperglycaemia by increasing glucose production.

Hsu et al. (1981) observed that xylazine induced hyperglycaemia in cattle. They found that intravenous injection of xylazine, 15-150 μg/kg body weight induced a dose dependent hyperglycaemia and hypoinsulinemia for 3-4 hours post-administration.
Goranov et al. (1983) administered xylazine 0.04 - 0.08 mg/kg body weight by subcutaneous and intramuscular route in sheep and cattle. They observed increase in blood sugar level from 50 mg percent to 200 mg percent for a period of 3 hours.

Peshin and Kumar (1983) reported that when xylazine was administered intramuscularly 0.22 mg/kg body weight with prior administration of 0.04 mg/kg body weight in buffaloes, there was significant increase in glucose level after 30 minutes of xylazine administration.

Ali et al. (1989) studied the effect of propionylpromazine, xylazine, acepromazine or chlorpromazine on blood glucose when administered intramuscularly in six healthy dromedaries. They observed that four drugs particularly xylazine and propionyl promazine, produced significant hyperglycaemia.

Raptopoulous (1990) reported the role of hypoxia in the hyperglycaemic effect of xylazine in sheep. Xylazine induced a rise in serum glucose concentration which, following a sharp increase in the first 30 minutes, remained at similar high levels (about 165% of the pre-injection value) for another 2.5 hours.

He concluded that hypoxia by itself can induce hyperglycaemia, but its prevention by administering oxygen did not alter the hyperglycaemic effect of xylazine. It was concluded that the hypoxia following administration of xylazine
was not severe enough to produce a rise in catecholamine concentrations eliciting hyperglycaemia.

Robertson et al. (1990) studied the effect of xylazine on blood glucose level in neonatal foals. They stated that unlike adults, intravenous administration of xylazine did not produce hyperglycaemia in foals.

Marais et al. (1991) studied the effect of xylazine and fentanyl of metabolites in karakul sheep and blesbok. Blood samples were collected 40 minutes before and 40 minutes after intramuscular injection of 2.5 and 5.0 mg xylazine and 5 and 10 mg fentanyl, respectively. They observed a significant increase in glucose concentration and a decrease in insulin. It is suggested that the concentration of xylazine and fentanyl may act directly on pancreatic β-cells to inhibit the secretion of insulin, which consequently affects circulating concentration.

Patel (1991) reported the use of xylazine 0.1, 0.2, and 0.3 mg/kg body weight intramuscularly in calves. He found significant increase in blood glucose level two hours after the administration of xylazine, which reduced after six hours and returned to near normal level after 24 hours of administration.

Balakishan (1993) reported the effect of epidural administration of xylazine and lignocaine-HCl in buffalo calves. He observed that there was increased blood glucose level with xylazine administration.
More et al. (1993) reported that the blood chemistry revealed hyperglycaemia at maximum depth of anaesthesia when diazepam-xylazine-ketamine anaesthesia was administered in twelve cow calves.

Short et al. (1972) observed significant decrease in potassium level ranging from 4.4 to 4.0 mEq/litre 2 hours after the administration of xylazine alone in horses and changes in total serum protein values ranging from 7.27 to 7.05 gm percent was also observed.

Botelho (1977) reported that sixteen cattle were given 10 mg 2% xylazine chlorhydrate/100 kg body weight intramuscularly and compared with five controls. It was claimed that serum proteins had decreased significantly an hour after injection but showed a significant increase between the first and sixth hour to a value approaching their original level.

Eichner et al. (1979) observed that uptake by the vascular system of extravascular fluid could explain this phenomenon. However, it should be noted that no changes in plasma Na⁺,K⁺, or protein concentrations were noted as a result of xylazine administration intravenously in beef cattle.

Kumar et al. (1979) found that there was no difference in serum electrolytes (Na⁺,K⁺ and Cl⁻) at various intervals, when xylazine and ketamine were administered intramuscularly in dogs.
Kumar and Thurmon (1979) found biochemical changes, a slight rise in potassium and a decrease in sodium concentration when xylazine at 0.22 mg/kg body weight was administered in goats.

Peshin et al. (1980) studied cardiovascular, respiratory, haematologic and sedative effects of xylazine in dogs. They observed that a mild increase in serum sodium and a decrease in potassium and chlorides were within physiological limits. It could be presumed that the blood dilution in this respect is not caused by water or electrolyte retention.

Jacobson (1983) studied the effect of ketamine and xylazine combination on serum chemicals when used for immobilizing springbok. He found that serum potassium was significantly lower within 15 minutes of drug administration.

Peshin et al. (1983) observed that when xylazine was administered intramuscularly at 0.22 mg/kg body weight with and without prior administration of atropine at the rate of 0.04 mg/kg in buffaloes, no significant change in serum Na⁺, K⁺ and Cl⁻ was observed. No changes in serum proteins were observed.

Gasthuys et al. (1986) reported that in five mares atropine (1 mg/100 kg body weight) and xylazine (40 mg/100 kg body weight) injected intravenously had no influence on Na⁺ and K⁺ concentration in serum. One mare showed pronounced diuresis with greater Na⁺ and K⁺ in urine.
Seal et al. (1987) observed that six Panthera tigris tigris were immobilized five times at 2 weeks intervals with ketamine and xylazine mixture at different dose levels. There was acute changes in chloride and sodium as a function of xylazine dose.

Ravikumar et al. (1992) reported the studies on infra-anal cystorrhaphy in experimental calves. The calves were tranquilized by intramuscular administration of 2% xylazine (0.1 mg/kg). The low epidural analgesia was achieved by injection of 5 ml of 2% lignocaine hydrochloride. They found that sodium level was elevated slightly following surgery which could be due to retention of small quantity of urine because of post-surgical pain. Potassium levels remained unchanged and chloride levels declined following surgery which could be attributed to post-surgical anorexia leading to nutritional chloride deficiency. However, the above changes were transient and returned to normal early.
MATERIALS AND METHODS
3. MATERIALS AND METHODS

The present study was carried out on eighteen male camels having various surgical problems brought to the Surgery Clinic. The age of the camels ranged from 5 years to 12 years and weighing between 565 and 965 kg. The site of administration of epidural anaesthesia was at sacrococcygeal space. The induction of anaesthesia was preceded by keeping camels off feed and water for 24 hours in all 18 clinical cases. The site was prepared for aseptic epidural injection of xylazine.

In first group of six clinical cases of camels, xylazine hydrochloride was administered at the dose rate of 0.1 mg/kg body weight, epidurally. In this group, dressing of tail wound was carried out.

In second group, xylazine was administered at the dose rate of 0.2 mg/kg body weight, epidurally. Tail docking was accomplished in all six clinical cases of tail gangrene in camels under this dose regimen.

In third group, xylazine was administered at the dose rate of 0.3 mg/kg body weight, epidurally. One camel had an extensive granulating wound on anterior aspect of hock joint. In two camels, orchiectomy was done. In one camel debridement and dressing of saddle gall was attempted. In one camel,
dressing of scrotal bite wound was accomplished. Tail docking was done in one clinical case of tail gangrene in camel under this dose regimen.

As envisaged in the plan of study, clinical signs in these cases prior to and after administration of xylazine epidural anaesthesia were recorded carefully. The post-administrable signs were observed from the onset of anaesthesia till complete recovery.

For determining haematological parameters, 5 ml of whole blood sample was collected from each camel prior to administration of anaesthetic in a sterile vial containing 5 mg ethyldiamine tetra-acetic acid (EDTA) as an anticoagulant.

For determining biochemical parameters, another 10 ml of whole blood sample was collected from each camel prior to administration of anaesthetic in a sterile test tube without anticoagulant.

As proposed, post-anaesthetic haematological and biochemical parameters were studied at 0 (i.e. after the onset of anaesthesia in tail), 2, 4, and 24 hours. This comprised of collecting 5 ml of whole blood for haematological parameters at each interval. Likewise blood samples of 10 ml were collected for determining biochemical parameters at each interval.
The plan of study consisted of following steps:

3.1. Administration of anaesthesia.
3.2. Clinical study.
3.3. Haematological study.
3.4. Biochemical study.

3.1. ADMINISTRATION OF ANAESTHESIA

3.1.1. Materials required for the administration of epidural anaesthesia:

i. Sterilized leurlock syringes of 2 ml, 5 ml, 10 ml and 20 ml.

ii. Sterilized needles of 16 and 18 gauge.

iii. Savlon® hospital concentrate in 1:30 dilution for scrubbing the site.

iv. Two percent solution of Xylaxin**.

v. Distilled water ampules.

vi. Other materials like scissors, shaving blade, soap, sterilized gauze, cotton and ropes.

vii. Sterilized surgical pack for correcting surgical affections.

* The Alkali and Chemical Corporation of India Limited.
** Indian Immunologica, Hyderabad, India.
3.1.2. Restraint of the camel:

The camel was restrained in sitting position for administration of anaesthesia, clinical examination and surgical intervention. The restraining of camel was obtained by tying fore as well as hind limbs with the help of ropes.

3.1.3. Preparation of the site:

The site of injection was shaved, cleaned and thoroughly washed with soap and water and then scrubbed with savlon 1:30 solution. Tincture of iodine was painted on the site before and after each prick. In all the trials, strict aseptic procedure was adopted.

3.1.4. Location of site and technique of injection for epidural anaesthesia:

After restraining the camel, the sacro-coccygeal space was located. For locating sacro-coccygeal space, the tail was grasped with the left hand about 25 cms below the base and gently raised up and down. A depression between last sacral and first coccygeal vertebrae was felt by right hand thumb. A 16 gauge and 4 cms long needle was introduced with the right hand at an angle of 45 to 70 degree on the midline. A 45 degree angle placement of needle, contrary to experimental trials, proved more practical and convenient for introducing the needle.
in sacro-coccygeal space. With the bevel of the needle facing anteriorly, it was pushed 2 cm in the spinal canal and threading of needle was ascertained. The intrusion of epidural space was ascertained by injecting 5 ml of distilled water without showing any resistance. This was followed by injecting the calculated dose of xylazine in the space thereto.

3.2 CLINICAL STUDY

The sequential study of the xylazine epidural anaesthesia in clinical cases of camels included the induction of anaesthesia, the extent of anaesthesia, degree of anaesthesia, duration of anaesthesia and recovery period. Simultaneously, salivation, neck relaxation and regurgitation, if any, were observed after administration of xylazine epidurally in clinical cases of camels. The extent of anaesthesia was determined by response to skin prick, using a 20 gauge hypodermic needle at tail, anus, perineum, scrotal, sheath, croup, sacrum, lumbar, thorax, hip, thigh and hock regions. The degree of desensitization graded as +1 (poor), +2 (moderate), +3 (good) and +4 (very good) in the post-epidural injection period. The scores, thus, given to each animal to estimate the degree of desensitization were quite akin. The mapping of extent of anaesthesia was on the basis of these average scores. The scores below one were treated as inappreciable analgesia.
The pulse rate was recorded from ventral coccygeal artery. The respiration rate was recorded from abdominal movements before administration of xylazine epidurally and at 0 i.e after the onset of anaesthesia on tail, 2, 4, and 24 hours post-administration. Rectal temperature was also recorded before and after at 0 i.e after the onset of anaesthesia on tail, 2, 4, and 24 hours administration of xylazine epidurally. Ruminal motility could not be recorded due to abdominal respiration.

3.3 HAEMATOLOGICAL STUDY

Pre-anaesthetic haematological studies comprised of total erythrocyte count (TEC), total leucocyte count (TLC), haemoglobin concentration (Hb), and packed cell volume (PCV). For this 5 ml of whole blood was collected in a sterile vial containing 5 mg ethyldiamine tetra-acetic acid (EDTA) as an anticoagulant. Whole blood samples were taken from jugular vein before administration of anaesthetic. To determine post-anaesthetic haematological values, blood samples were collected at intervals of 0 (i.e after the onset of anaesthesia on tail), 2, 4, and 24 hours.

Following haematological parameters were studied:

a. Haemoglobin,

b. Packed cell volume,
c. Total erythrocyte count, and
da. Total leucocyte count.

These were determined by standard techniques described by Schalm (1965).

3.4 BIOCHEMICAL STUDY

To determine the pre-anaesthetic biochemical parameters, 10 ml of blood samples without an anticoagulant were collected in sterile test tubes for serum collection. For calculating post-anaesthetic biochemical parameters, blood samples were collected at intervals of 0 i.e. the onset of anaesthesia on tail, 2, 4, and 24 hours. Serum was collected after centrifuging the blood samples at 3000 rpm for five minutes. These samples were stored in sterile vials at -4°C till used for different biochemical estimations. These serum samples were used to determine total proteins, glucose, chloride, sodium and potassium.

Following biochemical parameters of serum analysed:

a. Total serum protein,
b. Serum glucose,
c. Serum chloride,
d. Serum sodium, and
e. Serum potassium.
(a) Total Serum Protein:

The technique adopted for estimation of total serum protein was as per Greenberg (1929) described in "Gradwohl's Clinical Laboratory Methods of Diagnosis (1970)."

(b) Serum Glucose:

Method of Nelson and Somogyi (1945) was used to determine serum glucose.

c) Serum Chloride:

"Mercuric Nitrate Reagent Method" of Schales and Schales (1941) was used to determine chloride in serum.

d) Serum Sodium and (e) Serum Potassium:

Serum sodium and potassium were estimated by using flame photometer (Mediflame 127, Systronics).

**STATISTICAL METHODS.**

The data obtained in the research work undertaken were analysed according to the methods given by Steel and Torrie (1980) and significance of mean difference were calculated by students' t test (Snedecor and Cochran, 1967).
RESULTS
The present study was carried out on eighteen clinical cases of male camels having various surgical affections brought to the Surgery Clinic. The caudal epidural anaesthesia was induced with xylazine hydrochloride. Xylazine hydrochloride, at the dose regimens of 0.1 mg/kg, 0.2 mg/kg and 0.3 mg/kg body weight was administered epidurally into sacro-coccygeal space in eighteen camels. This study was also pertinent to evaluate the effectiveness and safety of xylazine as an epidural anaesthetic in clinical cases of camels, with special reference to clinical, haematological and biochemical observations.

4.1 Clinical observations:

4.1.1 Induction period (Table 1 and Fig 1).

The mean induction period observed in the dose rates of 0.1, 0.2 and 0.3 mg/kg body weight was 15, 5 and 3 minutes, respectively. Induction period seemed to be dose dependent. It became evident that with the dose regimen of 0.1 mg/kg body weight, the mean induction period was found to be significantly longer when compared to dose regimens of 0.2 and 0.3 mg/kg.
Table (1). Effect of epidural administration of xylazine on several clinical observations in clinical cases of camels (n=6).

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Clinical Observations</th>
<th>Dose rates (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean induction time (minutes)</td>
<td>0.1</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Mean duration of anesthesia (minutes)</td>
<td>145</td>
</tr>
<tr>
<td>3</td>
<td>Mean recovery period (minutes)</td>
<td>160</td>
</tr>
</tbody>
</table>
Figure 1.

MEAN INDUCTION PERIOD

Induction Period (minutes)

Dose Rates

0.1

0.2

0.3

M N U F S
4.1.2 Extent and degree of anaesthesia (Table 2.3 and 4).

In the animals given xylazine hydrochloride at the dose rate of 0.1 mg/kg body weight epidurally, the anaesthesia was found to be poor in the tail after 15 minutes of its injection. But moderate anaesthesia was observed from 20 to 90 minutes followed by poor to moderate anaesthesia in a decreasing order upto 160 minutes. The anaesthesia of part, other than the tail was not appreciable in this dose rate.

In the animals given xylazine hydrochloride at the dose rate of 0.2 mg/kg body weight epidurally, the anaesthesia of the tail was found to be poor to moderate from 5 to 10 minutes, moderate to good upto 30 minutes, good to very good upto 120 minutes and thereafter, progressively became poor upto 230 minutes post-injection. Almost similar trend was observed for the analgesia of anus but poor to good anaesthesia was observed at perineum from 15 to 20 minutes and thereafter, it became moderate to good upto 140 minutes followed by a moderate to poor upto 200 minutes. An almost similar trend was observed at croup region except that poor anaesthesia commenced at 10th minute which progressively increased to good upto 70 minutes, between good to moderate upto 160 minutes followed by poor anaesthesia upto 180 minutes. A poor to moderate anaesthesia
from 30 to 70 minutes post-injection was observed at scrotum followed by a progressive decrease upto 160 minutes. Inappreciable analgesia was observed at sheath. A poor analgesia commenced at sacral and hip region on 15 and 20 minutes, respectively post-injection which progressively increased from moderate to good upto 100 minutes followed by a progressive decrease upto 160 minutes. However, the analgesia at thigh region remained poor to moderate 30 to 100 minutes followed by progressive decreased upto 160 minutes. The anterior ascendancy was also studied to determine the extent of epidural anaesthesia, a poor to moderate anaesthesia was observed at lumbar and thoracic region commencing at 30 to 40 minutes, 160 and 120 minutes, respectively. A poor analgesia was observed at hock region from 30 to 140 minutes post-injection. The analgesia remained inappreciable below hock region.

In animals given xylazine hydrochloride at the dose rate of 0.3 mg/kg body weight epidurally, a moderate anaesthesia was observed at tail region as early as 3 minutes, post-injection. It was rated as good to very good upto 180 minutes followed by very good to good upto 290 minutes, good to moderate upto 320 minutes and moderate to poor upto 380 minutes, post-injection. The analgesia at anus and croup region commenced at poor rate on
10th minute and thereafter, progressively increased and became moderate to good upto 40 minutes followed by good to very good upto 160 minutes post-injection. It became good to moderate upto 240 and 260 minutes and thereafter, became poor upto 320 and 350 minutes, respectively. A poor rate anaesthesia commenced at scrotum after 20 minutes which progressively became moderate at 40 minutes, good at 160 minutes followed by a progressively poor analgesia upto 260 minutes. However, anaesthesia at sheath remained poor from 50 to 160 minutes. A similar rating was observed at sacral, hip and thigh region where the poor anaesthesia progressively increased between moderate to good upto 160 minutes followed by a progressive decrease to poor anaesthesia upto 230 minutes. A poor to moderate anaesthesia was observed at thoracic region from 100 to 160 minutes post-injection whereas, similar type of anaesthesia was observed at lumbar region from 60 to 180 minutes. A poor to moderate anaesthesia was observed at hock between 120 and 180 minutes. The anaesthesia below hock joint remained inappreciable.
Table—(2). Evaluation of the extent and degree of epidural anaesthesia in camels with the dose rate of 0.1 mg/kg body weight

<table>
<thead>
<tr>
<th>Time since injection (minutes)</th>
<th>Extent of anaesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tail</td>
</tr>
<tr>
<td>3</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>0.33</td>
</tr>
<tr>
<td>10</td>
<td>0.66</td>
</tr>
<tr>
<td>15</td>
<td>1.16</td>
</tr>
<tr>
<td>20</td>
<td>1.16</td>
</tr>
<tr>
<td>40</td>
<td>2.16</td>
</tr>
<tr>
<td>60</td>
<td>2.00</td>
</tr>
<tr>
<td>120</td>
<td>2.50</td>
</tr>
<tr>
<td>160</td>
<td>1.16</td>
</tr>
<tr>
<td>180</td>
<td>0.50</td>
</tr>
<tr>
<td>200</td>
<td>0.16</td>
</tr>
<tr>
<td>210</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Interpretation of average scores mentioned in the table on the basis of:
+1 Mild, +2 Moderate, +3 Good and +4 Very good
Table-(3). Evaluation of the extent and degree of epidural anaesthesia in camels with the dose rate of 0.2 mg/kg body weight.

<table>
<thead>
<tr>
<th>Time since injection (minutes)</th>
<th>Tail</th>
<th>Anus</th>
<th>Perineum</th>
<th>Scrotum</th>
<th>Sheath</th>
<th>Grop</th>
<th>Sacral</th>
<th>Lumbar</th>
<th>Thorax</th>
<th>Hip</th>
<th>Thigh</th>
<th>Neck</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>1.33</td>
<td>0.83</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.66</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>1.83</td>
<td>1.00</td>
<td>0.66</td>
<td>0.16</td>
<td>0.00</td>
<td>1.00</td>
<td>0.66</td>
<td>0.50</td>
<td>0.00</td>
<td>0.50</td>
<td>0.50</td>
<td>0.33</td>
</tr>
<tr>
<td>15</td>
<td>2.16</td>
<td>1.00</td>
<td>1.00</td>
<td>0.16</td>
<td>0.00</td>
<td>1.33</td>
<td>1.00</td>
<td>0.50</td>
<td>0.00</td>
<td>0.83</td>
<td>0.50</td>
<td>0.33</td>
</tr>
<tr>
<td>20</td>
<td>2.83</td>
<td>1.50</td>
<td>1.50</td>
<td>0.50</td>
<td>0.33</td>
<td>1.83</td>
<td>1.66</td>
<td>0.16</td>
<td>0.16</td>
<td>1.00</td>
<td>0.66</td>
<td>0.33</td>
</tr>
<tr>
<td>40</td>
<td>3.50</td>
<td>2.30</td>
<td>2.30</td>
<td>1.50</td>
<td>0.50</td>
<td>2.00</td>
<td>2.16</td>
<td>1.33</td>
<td>1.16</td>
<td>2.16</td>
<td>1.83</td>
<td>1.16</td>
</tr>
<tr>
<td>60</td>
<td>3.66</td>
<td>3.16</td>
<td>2.83</td>
<td>2.00</td>
<td>0.50</td>
<td>3.00</td>
<td>2.50</td>
<td>1.65</td>
<td>1.50</td>
<td>2.50</td>
<td>2.00</td>
<td>1.33</td>
</tr>
<tr>
<td>120</td>
<td>3.16</td>
<td>3.00</td>
<td>2.50</td>
<td>1.33</td>
<td>0.33</td>
<td>2.50</td>
<td>1.66</td>
<td>1.16</td>
<td>1.00</td>
<td>2.30</td>
<td>1.66</td>
<td>1.00</td>
</tr>
<tr>
<td>180</td>
<td>2.00</td>
<td>1.66</td>
<td>1.16</td>
<td>0.50</td>
<td>0.16</td>
<td>1.33</td>
<td>0.66</td>
<td>0.33</td>
<td>0.16</td>
<td>0.83</td>
<td>0.83</td>
<td>1.00</td>
</tr>
<tr>
<td>200</td>
<td>1.63</td>
<td>1.50</td>
<td>1.00</td>
<td>0.33</td>
<td>0.00</td>
<td>0.66</td>
<td>0.33</td>
<td>0.16</td>
<td>0.16</td>
<td>0.46</td>
<td>0.59</td>
<td>0.00</td>
</tr>
<tr>
<td>250</td>
<td>1.33</td>
<td>1.33</td>
<td>0.50</td>
<td>0.33</td>
<td>0.00</td>
<td>0.30</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.16</td>
<td>0.16</td>
<td>0.00</td>
</tr>
<tr>
<td>300</td>
<td>0.66</td>
<td>0.66</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>360</td>
<td>0.33</td>
<td>0.33</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>420</td>
<td>0.16</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>470</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Interpretation of average scores mentioned in the table on the basis of:
+1 Mild, +2 Moderate, +3 Good and +4 Very good
Table—(4). Evaluation of the extent and degree of epidural anaesthesia in camels with the dose rate of 0.3 mg/kg body weight

<table>
<thead>
<tr>
<th>Time since injection (minutes)</th>
<th>Extent of anaesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tail</td>
</tr>
<tr>
<td>3</td>
<td>2.00</td>
</tr>
<tr>
<td>5</td>
<td>2.16</td>
</tr>
<tr>
<td>10</td>
<td>2.83</td>
</tr>
<tr>
<td>15</td>
<td>2.83</td>
</tr>
<tr>
<td>20</td>
<td>3.00</td>
</tr>
<tr>
<td>40</td>
<td>3.50</td>
</tr>
<tr>
<td>60</td>
<td>3.83</td>
</tr>
<tr>
<td>120</td>
<td>3.83</td>
</tr>
<tr>
<td>180</td>
<td>3.83</td>
</tr>
<tr>
<td>240</td>
<td>3.50</td>
</tr>
<tr>
<td>260</td>
<td>3.16</td>
</tr>
<tr>
<td>320</td>
<td>2.30</td>
</tr>
<tr>
<td>380</td>
<td>1.33</td>
</tr>
<tr>
<td>440</td>
<td>0.50</td>
</tr>
<tr>
<td>470</td>
<td>0.50</td>
</tr>
<tr>
<td>620</td>
<td>0.33</td>
</tr>
<tr>
<td>750</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Interpretation of average scores mentioned in the table on the basis of:
+1 Mild, +2 Moderate, +3 Good and +4 Very good
4.1.3 Duration of anaesthesia (Table 1 and Fig 2).

The mean duration of anaesthesia observed in the dose regimens of 0.1 mg/kg, 0.2 mg/kg and 0.3 mg/kg body weight was 145 minutes, 225 minutes and 377 minutes, respectively. Duration of anaesthesia seemed to be dose dependent.

4.1.4 Recovery period (Table 1 and Fig 3).

Recovery period from epidural anaesthesia was significantly longer in the animals with the dose regimen of 0.3 mg/kg body weight. Mean recovery period observed in the dose regimens of 0.1, 0.2 and 0.3 mg/kg body weight was 160 min., 230 min. and 380 min., respectively. Recovery was smooth and uncomplicated in all the dose regimens.

4.1.5 Rectal temperature (Table 5 and Fig 4).

With the dose rate of 0.1 mg/kg body weight, non-significant change in the value of rectal temperature was observed throughout the period of study. Values were showing fluctuating trends but remained within the physiological range.

With 0.2 and 0.3 mg/kg body weight doses, there was a significant (P<0.05) decrease in rectal temperature from 0 hour to 2 hours and from 2 hours to 4 hours in post-administration period, respectively, when compared with pre-administration values. Rectal temperature fell to minimum level at 2 hours (97.66 ± 0.446), 4 hours (95.80 ± 0.604) in the dose rates of 0.2 and 0.3 mg/kg body weight, respectively.
Figure 2.

MEAN DURATION OF ANAESTHESIA

Duration of Anaesthesia (minutes)
Table-(5). Effect of epidural administration of xylazine on rectal temperature (°F) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Before administra-tion</td>
<td>98.70 ± 0.446</td>
<td>98.85 ± 0.277</td>
<td>97.70 ± 0.399</td>
</tr>
<tr>
<td>2.</td>
<td>After Induction</td>
<td>98.62 ± 0.491</td>
<td>97.83 ± 0.352*</td>
<td>97.11 ± 0.297</td>
</tr>
<tr>
<td>3.</td>
<td>2 hours</td>
<td>98.46 ± 0.305</td>
<td>97.66 ± 0.446*</td>
<td>96.03 ± 0.304*</td>
</tr>
<tr>
<td>4.</td>
<td>4 hours</td>
<td>98.33 ± 0.494</td>
<td>98.13 ± 0.512</td>
<td>95.80 ± 0.664*</td>
</tr>
<tr>
<td>5.</td>
<td>24 hours</td>
<td>98.81 ± 0.360</td>
<td>99.91 ± 0.551</td>
<td>99.26 ± 0.590</td>
</tr>
</tbody>
</table>

* P < 0.05
Figure 4.

RECTAL TEMPERATURE

<table>
<thead>
<tr>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
<tr>
<td>99.5</td>
</tr>
<tr>
<td>99.0</td>
</tr>
<tr>
<td>98.5</td>
</tr>
<tr>
<td>98.0</td>
</tr>
<tr>
<td>97.5</td>
</tr>
<tr>
<td>97.0</td>
</tr>
<tr>
<td>96.5</td>
</tr>
<tr>
<td>96.0</td>
</tr>
<tr>
<td>95.5</td>
</tr>
<tr>
<td>95.0</td>
</tr>
</tbody>
</table>

Recording Time

Befo.  0 hrs.  2 hrs.  4 hrs.  24 hrs.

Dose Rate
- 0.1
- 0.2
- 0.3
4.1.6 Respiration rate (Table 6 and Fig 5).

With the dose rates of 0.1 and 0.2 mg/kg body weight, non-significant change in the value of respiration rate was observed throughout the period of study. Values were showing fluctuating trends but remained within the physiological range. While with the dose rate of 0.3 mg/kg body weight, respiration decreased significantly at the intervals from 2 to 4 hours after xylazine administration.

4.1.7 Pulse rate (Table 7 and Fig 6).

With the dose rates of 0.1 and 0.3 mg/kg body weight non-significant change in the value of pulse rate was observed throughout the period of study. Values were showing fluctuating trends but remained within the physiological range.

With the dose rate of 0.2 mg/kg body weight, pulse rate decreased significantly (P<0.05) after xylazine administration. The pulse rate was found to be 31.66 ± 1.229 (0 hour), 26.66 ± 1.855 (2 hours) and 26.83 ± 2.023 (4 hours) in the dose rate of 0.2 mg/kg body weight.

4.1.8 Clinical trial (Table 8).

The three dose regimens of xylazine viz. 0.1, 0.2 and 0.3 mg/kg body weight were given epidurally to evaluate the clinical application mentioned in table No.8.
Table-(6). Effect of epidural administration of xylazine on respiration rate (per minute) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>DOSE RATES (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Before administra-tion.</td>
<td>10.83 + 1.400</td>
</tr>
<tr>
<td></td>
<td>After Induction</td>
<td>11.50 + 0.619</td>
</tr>
<tr>
<td></td>
<td>(0 hour)</td>
<td>11.00 + 0.774</td>
</tr>
<tr>
<td>2.</td>
<td>2 hours</td>
<td>10.00 + 0.447</td>
</tr>
<tr>
<td></td>
<td>4 hours</td>
<td>08.50 + 1.333</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>10.32 + 1.542</td>
</tr>
</tbody>
</table>

* P < 0.05
Table—(7). Effect of epidural administration of xylazine on pulse rate (per minute) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>DOSE RATES (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before administra-</td>
<td>0.1</td>
</tr>
<tr>
<td>1.</td>
<td>tion.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 hours</td>
<td>25.33 ± 3.363</td>
</tr>
<tr>
<td>2.</td>
<td>After Induction</td>
<td>31.50 ± 3.685</td>
</tr>
<tr>
<td></td>
<td>(0 hour)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2 hours</td>
<td>27.67 ± 3.362</td>
</tr>
<tr>
<td>4.</td>
<td>4 hours</td>
<td>30.33 ± 3.794</td>
</tr>
<tr>
<td>5.</td>
<td>24 hours</td>
<td>33.83 ± 3.270</td>
</tr>
</tbody>
</table>

* P < 0.05
Table- (8). Number of animals and surgical affections treated under xylazine epidural anaesthesia in clinical cases of camels.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Affections</th>
<th>Total number of animals</th>
<th>Dose rate (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tail wound</td>
<td>6</td>
<td>0.1</td>
</tr>
<tr>
<td>2</td>
<td>Tail gangrene</td>
<td>6</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>Scrotal bite wound</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>4</td>
<td>Orchiectomy</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>5</td>
<td>Granulating wound at anterior aspect of hock joint</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>6</td>
<td>Saddle gall</td>
<td>1</td>
<td>0.3</td>
</tr>
</tbody>
</table>
Figure : 5.

RESPIRATION RATE

![Graph showing respiration rate over time with different dose rates indicated.]
Figure 6.

PULSE RATE

Dose Rate

- X - 0.1
- O - 0.2
- △ - 0.3

24 hrs.

Recording Time

4 hrs.

2 hrs.

0 hrs.

Before

42
40
38
36
34
32
30
28
26
24
22

Pulse rate (per minute)
4.2 **Haematological observations.**

4.2.1 **Haemoglobin (Hb) (Table 9 and Fig 7).**

In all the three dose regimens, non-significant change in the value of haemoglobin concentration was observed throughout the period of study. Values were showing fluctuating trends but remained within the physiological range.

4.2.2 **Packed cell volume (PCV) (Table 10 and Fig 8).**

In all the three dose regimens, there was non-significant change in the value of PCV was observed throughout the period of study. Of course, values were showing fluctuating trends but remained within the physiological range.

4.2.3 **Total erythrocyte count (TEC) (Table 11 and Fig 9).**

Likewise, in the dose regimens of 0.1 and 0.3 mg/kg body weight, non-significant change in the values of TEC was observed throughout the period of study.
Table (9). Effect of epidural administration of xylazine on haemoglobin (gm %) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>DOSE RATES (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before administra-</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>tion.</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Before administra-</td>
<td>09.63 ± 1.289</td>
</tr>
<tr>
<td>2.</td>
<td>After Induction</td>
<td>09.53 ± 1.270</td>
</tr>
<tr>
<td>3.</td>
<td>2 hours</td>
<td>09.26 ± 1.170</td>
</tr>
<tr>
<td>4.</td>
<td>4 hours</td>
<td>09.26 ± 1.171</td>
</tr>
<tr>
<td>5.</td>
<td>24 hours</td>
<td>09.50 ± 1.244</td>
</tr>
</tbody>
</table>

All means differences for intervals were found statistically non-significant (P<0.05)
Table-(10). Effect of epidural administration of xylazine on packed cell volume (%) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>Dose Rates (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>1.</td>
<td>Before administra-</td>
<td>24.00 ± 2.435</td>
</tr>
<tr>
<td>tion.</td>
<td></td>
<td>22.66 ± 0.954</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27.32 ± 2.871</td>
</tr>
<tr>
<td>2.</td>
<td>After Induction</td>
<td>21.66 ± 2.105</td>
</tr>
<tr>
<td></td>
<td>(0 hour)</td>
<td>21.83 ± 1.194</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.83 ± 2.600</td>
</tr>
<tr>
<td>3.</td>
<td>2 hours</td>
<td>20.33 ± 1.909</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.00 ± 1.390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.32 ± 2.752</td>
</tr>
<tr>
<td>4.</td>
<td>4 hours</td>
<td>20.33 ± 1.801</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21.23 ± 0.557</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.46 ± 1.977</td>
</tr>
<tr>
<td>5.</td>
<td>24 hours</td>
<td>23.00 ± 2.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.00 ± 0.816</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.83 ± 3.004</td>
</tr>
</tbody>
</table>

All means differences for intervals were found statistically non-significant (P<0.05).
Table (11). Effect of epidural administration of xylazine on total erythrocyte count (million/cumm) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>Dose Rates (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before administra-</td>
<td>11.24 ± 1.468</td>
</tr>
<tr>
<td>2</td>
<td>After Induction</td>
<td>09.92 ± 1.080</td>
</tr>
<tr>
<td>3</td>
<td>2 hours</td>
<td>07.56 ± 0.902</td>
</tr>
<tr>
<td>4</td>
<td>4 hours</td>
<td>08.81 ± 1.241</td>
</tr>
<tr>
<td>5</td>
<td>24 hours</td>
<td>10.51 ± 1.079</td>
</tr>
</tbody>
</table>

* P < 0.05
Figure: 7.

HAEMOGLOBIN

![Graph showing changes in haemoglobin levels over time with different dose rates.]
Figure 8.

**PACKED CELL VOLUME**

![Diagram showing packed cell volume over time with different dose rates.](image-url)
**TOTAL ERYTHROCYTE COUNT**

![Graph showing total erythrocyte count over time with different dose rates.](image-url)
There was significant (P<0.05) decrease in TEC in the dose regimen of 0.2 mg/kg body weight. TEC decreased significantly at intervals from 0 to 4 hours post-administration of xylazine in the dose rate of 0.2mg/kg body weight throughout the period of study. Thereafter, it showed gradual increase and touched the baseline, 4 hours post-administration of xylazine.

4.2.4 Total leucocyte count (TLC) (Table 12 and Fig 10).

Gradual decrease in TLC was observed in all the dose regimens at intervals from 0 to 4 hours and from 0 to 2 hours in the dose regimens of 0.1, 0.2 and 0.3 mg/kg body weight. The minimum values recorded were 7.99 ±0.857, 6.95 ±0.870 and 9.78 ±1.875 in the dose regimens of 0.1, 0.2 and 0.3 mg/kg body weight, but non-significant.

4.3 Biochemical observations.

4.3.1 Total serum protein (Table 13 and Fig 11).

With the dose regimens of 0.1 and 0.3 mg/kg body weight, non-significant change in the value of TSP was observed throughout the period of study.
Table-(12). Effect of epidural administration of xylazine on total leucocyte count (thousand/cumm) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>No.</th>
<th>Recording Time</th>
<th>Dose Rates (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before administra-</td>
<td>1.027 ± 1.622</td>
</tr>
<tr>
<td>2</td>
<td>After Induction</td>
<td>0.861 ± 1.010</td>
</tr>
<tr>
<td>3</td>
<td>2 hours</td>
<td>0.812 ± 0.893</td>
</tr>
<tr>
<td>4</td>
<td>4 hours</td>
<td>0.997 ± 0.857</td>
</tr>
<tr>
<td>5</td>
<td>24 hours</td>
<td>0.905 ± 1.580</td>
</tr>
</tbody>
</table>

All means differences for intervals were found statistically non-significant (P<0.05).
Table-(13). Effect of epidural administration of xylazine on total serum protein (gm/100ml) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Before administra-</td>
<td>05.53 ± 0.777</td>
<td>06.91 ± 0.499</td>
<td>08.14 ± 1.421</td>
</tr>
<tr>
<td></td>
<td>tion.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>After Induction</td>
<td>04.50 ± 0.760</td>
<td>06.25 ± 0.535</td>
<td>07.33 ± 1.311</td>
</tr>
<tr>
<td></td>
<td>(0 hour)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2 hours</td>
<td>04.10 ± 0.725</td>
<td>05.64 ± 0.199</td>
<td>05.83 ± 0.450</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>4 hours</td>
<td>04.68 ± 0.556</td>
<td>06.06 ± 0.555</td>
<td>05.44 ± 0.502</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>24 hours</td>
<td>05.24 ± 0.732</td>
<td>06.71 ± 0.546</td>
<td>06.79 ± 1.296</td>
</tr>
</tbody>
</table>

* P < 0.05
TOTAL LEUCOCYTE COUNT

Dose Rate
- 0.1
- 0.2
- 0.3

Figure: 10.

Total Leucocyte Count (thousand/cumm)

Recording time
0 hrs. 2 hrs. 4 hrs. 24 hrs.
Figure: 11.

TOTAL SERUM PROTEIN

![Graph showing Total Serum Protein (gm/100ml) over time with different dose rates.](image)

- Dose Rate
  - 0.1
  - 0.2
  - 0.3

Recording time

- Before
- 0 hrs.
- 2 hrs.
- 4 hrs.
- 24 hrs.
With the dose regimen of 0.2 mg/kg body weight, there was significant \((P<0.05)\) decrease in TSP at 2 hours post-administration of xylazine, when compared with pre-administration. Total serum protein reached minimum level at 2 hours \((5.61 \pm 0.199)\) in the dose regimen of 0.2 mg/kg body weight.

### 4.3.2 Serum glucose (Table 14 and Fig 12)

There was significant \((P<0.05)\) increase in the value of serum glucose in all the dose regimens. Gradual increase in serum glucose was observed in the dose regimens of 0.2 and 0.3 mg/kg body weight from 0 to 2 hours and from 2 to 4 hours, respectively. The maximum values recorded were 66.71 \(\pm\) 8.591, 162.31 \(\pm\) 10.436 and 216.76 \(\pm\) 21.760 in the dose regimens of 0.1, 0.2 and 0.3 mg/kg body weight. Thereafter, it started declining but not almost touched the pre-anaesthetic level at 24 hours post-administration of xylazine in all the dose regimens of xylazine.

### 4.3.3 Serum chloride (Table 15 and Fig 13)

In all the dose regimens values of serum chloride were found to be fluctuating with non-significant changes at different intervals of post-administration of xylazine. It was recorded minimum at 4 hours post-administration in all the three dose regimens of xylazine.
Table-(14). Effect of epidural administration of xylazine on serum glucose (mg/100ml) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>DOSE RATES (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>1.</td>
<td>Before administra-tion</td>
<td>35.78 ± 2.493</td>
</tr>
<tr>
<td>2.</td>
<td>After Induction (0 hour)</td>
<td>44.47 ± 3.960</td>
</tr>
<tr>
<td>3.</td>
<td>2 hours</td>
<td>66.71 ± 8.591*</td>
</tr>
<tr>
<td>4.</td>
<td>4 hours</td>
<td>64.50 ± 8.165*</td>
</tr>
<tr>
<td>5.</td>
<td>24 hours</td>
<td>46.73 ± 2.416*</td>
</tr>
</tbody>
</table>

* P < 0.05
Table—(15). Effect of epidural administration of xylazine on serum chloride (mEq/L) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
</table>
| 1      | Before administra-
| tion,  | 120.74 ± 4.065 | 123.49 ± 3.693 | 120.58 ± 2.135 |
| 2      | After Induction  | 117.05 ± 3.413 | 119.65 ± 5.380 | 117.49 ± 2.272 |
| 3      | (0 hour)         | 114.60 ± 4.747 | 119.70 ± 6.772 | 112.43 ± 3.230 |
| 4      | 2 hours          | 114.43 ± 4.724 | 119.42 ± 5.337 | 111.52 ± 3.179* |
| 5      | 4 hours          | 118.30 ± 3.119 | 120.28 ± 4.038 | 119.53 ± 1.941 |

* P < 0.05
SERUM CHLORIDE

Figure: 13.

Serum Chloride (mEq/L)

Recording time

Dose Rate
- - 0.1
- 0.2
- 0.3
4.3.4 Serum Sodium (Table 16 and Fig 14).

In all the three dose regimens values of serum sodium were found to be fluctuating with non-significant changes at different intervals post-administration of xylazine.

It was recorded maximum at 4 hours post-administration of xylazine in the dose regimen of 0.1 mg/kg body weight.

4.3.5 Serum Potassium (Table 17 and Fig 15).

Gradual decrease in serum potassium was observed in the dose regimens at intervals from 0 to 24 hours, except at 4 hours in the dose regimen of 0.1 mg/kg body weight. In all the three dose regimens values of serum potassium were found to be fluctuating with non-significant changes at different intervals after administration of xylazine. It was recorded minimum at 24 hours after administration in all the three dose regimens.
Table-(16). Effect of epidural administration of xylazine on serum sodium (mEq/L) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>Dose Rates (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before adminis-</td>
<td>143.00 $^{+} 3.651$</td>
</tr>
<tr>
<td></td>
<td>14.66 $^{+} 3.105$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>After Induction</td>
<td>144.66 $^{+} 2.403$</td>
</tr>
<tr>
<td></td>
<td>14.66 $^{+} 2.403$</td>
<td>151.16 $^{+} 6.215$</td>
</tr>
<tr>
<td>3</td>
<td>2 hours</td>
<td>144.66 $^{+} 2.321$</td>
</tr>
<tr>
<td>4</td>
<td>4 hours</td>
<td>154.50 $^{+} 6.540$</td>
</tr>
<tr>
<td>5</td>
<td>24 hours</td>
<td>146.83 $^{+} 3.102$</td>
</tr>
</tbody>
</table>

All means differences for intervals were found statistically non-significant (P<0.05).
Table-(17). Effect of epidural administration of xylazine on serum potassium (mEq/L) at different intervals in clinical cases of camels (n=6)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Recording Time</th>
<th>Dose Rates (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before administra-tion</td>
<td>05.66 ± 0.312</td>
</tr>
<tr>
<td></td>
<td>1 hour (0 hour)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After induction</td>
<td>05.50 ± 0.425</td>
</tr>
<tr>
<td></td>
<td>2 hours</td>
<td>05.33 ± 0.320</td>
</tr>
<tr>
<td></td>
<td>4 hours</td>
<td>05.81 ± 0.276</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>04.90 ± 0.425</td>
</tr>
</tbody>
</table>

All means differences for intervals were found statistically non-significant (P<0.05).
Figure 14.

SERUM SODIUM

Serum Sodium (mEq/L)

Recording time

Dose Rate

- 0.1
- 0.2
- 0.3
Figure: 15.

SERUM POTASSIUM

![Graph showing serum potassium levels over time for different dose rates.](image-url)
DISCUSSIONS
Epidural anaesthesia was induced on a sitting camel secured by rope halters. This position was found to be most safe, convenient, easy and did not produce any deleterious effect even after prolonged periods of procurement. Successful anaesthesia is essential for the performance of painless surgical affections from the humanitarian and technical efficiency point of view (Hall, 1966). The response of various anaesthetic agents differ from species to species. Very little is known about the various anaesthetic procedures in camel.

All the general anaesthetic procedures have several disadvantages. Macintosh and Smith (1962) considered general anaesthesia a journey from consciousness towards death. Large amounts of general anaesthetics delay recovery, disturb metabolism and may cause even death. Camel is a ruminant, thus as in cattle general anaesthesia should be used only in extreme cases and that too in minimum amounts to achieve sedation and the surgery may be performed under local infiltration.

The regional anaesthesia is practiced as a routine procedure for camel surgery because of its simplicity and advantages. Since the discovery of epidural anaesthesia by Benesch (1926), it has become most popular and standard
procedure at the hands of field Veterinarians especially in bovine obstetrical cases. The only snag with the use of local anaesthetic agent is analgesia of limited area for a short duration. For anaesthetizing the area beyond the perineal region, larger quantity of local anaesthetic will be required. This invariably results into motor nerves paralysis of hind limbs. Similarly for increasing duration of epidural analgesia, various combinations of local anaesthetic either with adrenaline or hyaluronidase have been tried with varying success.

Xylazine is a centrally acting non-narcotic analgesic with sedation and myorelaxant properties. It also possesses potent local anaesthetic properties (Knight, 1980). Xylazine is an alpha-2 adrenergic agonist commonly employed parenterally for sedation and analgesia in animals of different species. Use of xylazine as an epidural anaesthetic agent for perineal analgesia in horses was first reported by LeBlanc et al. (1988). Caudal analgesia lasting approximately for 2.5 hours was achieved without behavioural effects commonly associated with parenteral administration.

The precise mechanism of action of epidurally administered xylazine remains undetermined. It is believed that the analgesic effect is mediated by spinal alpha-2 adrenergic receptors, because the analgesia is antagonized by alphalz1, but
not alpha_1 or beta blockers (Brunson and Majors, 1987). Alpha_2 receptors inhibit the release of a spinal neurotransmitter, believed to be important in pain perception. Thus, inhibition of spinal transmission of painful stimuli is possible, using spinal or epidural alpha_2-adrenergic agonist. The advantage of spinal alpha_2 induced analgesia include attenuation of supraspinal side effects, prolonged duration of action and absence of diminished hind limbs strength.

Xylazine has been used epidurally in horses (LeBlanc *et al.*, 1988) and ponies (Fikes *et al.*, 1989) at the dose rates of 0.17 mg and 0.35 mg/kg body weight, respectively. Cattle are more sensitive to xylazine than are horses and ponies. Therefore, in the present study, xylazine hydrochloride was administered epidurally at the dose regimen of 0.1, 0.2 and 0.3 mg/kg body weight in eighteen clinical cases of camels. Each dose regimen included six clinical cases of camels having surgical affections caudal to lumbo-sacral junction.

5.1 Clinical observations

5.1.1 Induction period

The mean induction period observed in the dose regimen of 0.1 mg/kg (15 min.) was found to be significantly longer when
compared to the dose regimen of 0.2 mg/kg (5 min.) and the dose regimen of 0.3 mg/kg (3 min.). This longer induction period may be due to lesser dose as compared to the recommended dose of xylazine. In all eighteen clinical cases of camels, induction was smooth.

The present study has revealed that the mean induction period was found to be dose dependent in each dose regimen. This was also supported by Zaugg and Nussabaum (1990) in bovine and Jean et al. (1990) in cows who found that it took ten minutes for induction after epidural administration of xylazine at the dose rates of 0.07 mg and 0.05 mg/kg body weight, respectively.

Induction period was also influenced by route of administration as stated by Ali et al. (1989) in dromedaries. They recorded that anaesthesia was induced after four minutes of intramuscular administration of xylazine with a dose rate of 0.25 mg/kg body weight in camels.

5.1.2 Extent and degree of anaesthesia

With 0.1 mg/kg body weight.

In six clinical cases of camels, the xylazine hydrochloride was administered epidurally at the dose rate of 0.1 mg/kg
body weight, there was mild to moderate analgesia of tail. The analgesia of parts other than tail was not appreciable in this dose regimen. It was observed that this dose regimen was not sufficient to perform the surgery on tail, perineum and other part of hind limb. Apart from this, none of the animals had shown any sedation and salivation throughout the period of study.

However, in six camels dressing of tail wound was done under 0.1 mg/kg body weight dose regimen. The camels allowed dressing without showing any pain and resistance.

On the other hand contrareous findings had also been made by Balakishan (1993) who reported perfect analgesia throughout the surgical procedures done in standing position when 2% xylazine (0.05 mg/kg and 0.07 mg/kg) was administered epidurally in buffalo calves. Similar findings had also been reported by Ko et al. (1989) who reported 2% lidocaine at the dose rate of 0.2 mg/kg body weight and xylazine at the dose rate of 0.06 mg/kg body weight were administered separately epidurally in cows. They observed that xylazine produced a longer duration of perineal analgesia than lidocaine.

As per the revelation of this study, it was concluded that xylazine at the dose rate of 0.1 mg/kg body weight
epidurally was not enough to produce selective analgesia in tail and perineal region in clinical cases of camels. Because the depth of anaesthesia was dose dependent (Mangels, 1969) and species variation (Brook, 1930).

During this investigation, the sedation and salivation were not observed throughout the period of study with the dose regimen of 0.1 mg/kg body weight. This was substantiated by LeBlanc and Eberhart (1990) who observed similar findings in horses treated by xylazine at the dose rate of 0.17 mg/kg body weight administered epidurally.

With 0.2 mg/kg body weight.

In another six clinical cases of camels, xylazine hydrochloride was administered epidurally at the dose rate of 0.2 mg/kg body weight. The extent of anaesthesia was determined in following sequential order, while mapping the desensitization. Tail was first to be affected. This was followed by desensitization of croup, anal, perineal, scrotal, sacral, lumbar thoracic, hip, thigh and hock region. In this group of animals analgesia did not extend below hock region.

According to findings of this study the mean duration of surgical analgesia was recorded on tail, anal and croup region.
for 90, 60, and 10 minutes, respectively. Tail docking was accomplished in all six clinical cases of tail gangrene in camels under this dose regimen.

The findings of this study were congruous to the findings of Kumar et al. (1990). These workers had used xylazine administered epidurally at the dose rate of 0.2 mg/kg body weight in buffaloes. According to them, this dose rate provided good local analgesia for performing surgery in tail, perineal region and difficult after-birth. Further LeBlanc and Caron (1990) had also used xylazine epidurally in horses for clinical purposes. They administered xylazine at the dose rate from 0.17 to 0.22 mg/kg body weight into epidural space to facilitate various perineal manipulations like rectovaginal laceration repair and replacement of prolapsed rectum.

Salivation could not be observed throughout the period of analgesia under this dose regimen. But the duration of sedation varied from mild to moderate for 76.66 ± 20.273 minutes with same dose rate.

LeBlanc and Eberhart (1990) also used xylazine epidurally at the dose rate of 0.1 mg/kg body weight in horses. But this amount of xylazine was not able to produce sedation. But when xylazine was administered epidurally in the present
study in camels at the dose rate of 0.2 mg/kg body weight which was effective, landed credence to our findings.

With 0.3 mg/kg body weight.

In the remaining six clinical cases of camels, xylazine hydrochloride was administered at the dose rate of 0.3 mg/kg body weight, epidurally. The extent of anaesthesia under the same dose rate was observed in tail, croup, anal, perineal, scrotal, sheath, sacral, lumbar, thoracic, hip, thigh and hock region. The analgesia below the hock region remained inappreciable under this dose regimen. In this group, one camel had an extensive granulating wound on anterior aspect of hock joint. To facilitate healing it required removal of exuberant granulation. Debridement and dressing was accomplished without pain under this dose regimen. According to findings of present study, the duration of surgical analgesia was observed on tail, croup anal, perineal and scrotal for 270 min., 160 min., 190 min., 40 min. and 20 min., respectively.

It could be concluded that this dose regimen was enough to undertake the surgical intervention involving tail, anal, vaginal, vulva and perineal regions of sufficient duration. The foregoing claim was also supported by Kumar et al. (1990). Who used xylazine epidurally in buffaloes, at the dose rate of
0.2 mg/kg body weight for doing same operations. LeBlanc and Caron (1990) also supported the potency of this dose rate when given epidurally in horses.

In two camels, orchietomy was done under this dose regimen. In these animals the mean duration of surgical anaesthesia was found to be of 115 minutes. This duration was sufficient for doing orchietomy. However, in one camel the duration of analgesia was not long enough for surgical intervention in scrotal region. The reason for this could be insufficient closure of intervertebral foraminae of the spinal column and the consequent escape of anaesthetic solution through these foraminae without exerting any action on spinal nerves. In fatty camel, fat deposited in epidural space could block forward flow of anaesthetic solution. Brook (1930) had also attributed these factors responsible for insufficient analgesia when he employed epidural anaesthesia.

During this study an attempt was made to study the mean duration of sedation. The mean sedation period lasted 206.66 ± 36.757 minutes. The muscular relaxation was also studied. The muscular relaxation was most manifested in neck muscles. A mild to moderate relaxation which lasted 202.50 ± 38.248 minutes was evident. This concurred with the findings of Kumar et al. (1990). They reported excellent sedation and
salivation in buffaloes when xylazine was administered, epidurally at the dose rate of 0.2 mg/kg body weight. Peshin et al. (1980) had also supported the same phenomenon after using xylazine intramuscularly at the dose rate of 0.4 mg/kg body weight. They had reported mild sedation ($\bar{R} = 15.3 \pm 4.9$ min.) and neck relaxation ($\bar{R} = 22.7 \pm 3.9$ min.) in adult camel.

In one clinical case debridement and dressing of saddle gall was attempted. The anaesthetic effect had not been shown as pain at the time of debridement was not annihilated. It could be concluded that ascendency of epidural anaesthesia was not achieved up to thoracic region with this dose rate. But according to Peshin et al. (1980) who gave xylazine intramuscularly at the dose rate of 0.4 mg/kg body weight. Surgical analgesia for shorter surgical intervention was achieved in clinical cases of adult camel.

In none of the clinical cases, ataxia was not manifested after recovery from anaesthesia in all these dose regimens. It could be concluded that the epidural use of xylazine induced blockade of only sensory fibers without affecting autonomic or lower motor neurons in lumbosacral intumescence.
Regurgitation of ingesta, tympany and retention of urine are very common anaesthetic accidents with general or regional anaesthesia. Such accidents which ensue during sedation or in post-operative period were not witnessed during this study.

5.1.3 Duration of anaesthesia

The mean duration of anaesthesia observed in the dose regimen of 0.3 mg/kg (377 min.) was found to be significantly longer when compared to dose regimen of 0.2 mg/kg (225 min.) and dose regimen of 0.1 mg/kg (145 min.).

According to the findings of this study on clinical cases of camels, the mean duration of anaesthesia was found to be dose dependent in each dose regimen. This had also been substantiated by LeBlanc et al. (1988) and LeBlanc and Caron (1990) in horses. According to them the anaesthesia lasted from 2.5 hours and 3.5 hours after epidural administration of xylazine at the dose rate of 0.17 mg/kg and 0.17 to 0.22 mg/kg of body weight, respectively. Such like findings as regards the duration of anaesthesia of 247 ± 58 minutes and 120 minutes was observed by Fikes et al. (1989) in ponies and Jean et al. (1990) in cows, respectively after epidural administration of xylazine at the dose rate of 0.35 mg/kg and 0.05 mg/kg of body weight, respectively.
Ali et al. (1989) had also concurred to such findings of the present study about duration of anaesthesia of $3.1 \pm 0.4$ hours in healthy dromedaries after intramuscular administration of xylazine at the dose rate of 0.25 mg/kg of body weight.

On the other hand contrareous reporting had also been made by Gahlot and Chouhan (1992) who described administration of epidural anaesthesia at sacro-coccygeal space using 30-50 ml of 2% lignocaine HCl in camels. The duration of analgesia was 40-60 minutes, whereas, duration of analgesia was 75-120 minutes with 100-150 ml of lignocaine.

5.1.4 Recovery period

Recovery period from epidural anaesthesia was significantly longer in the animals with the dose regimen of 0.3 mg/kg body weight. Mean recovery period observed in the dose regimens of 0.1, 0.2 and 0.3 mg/kg body weight was 160 min., 230 min. and 380 min., respectively. The present study has revealed that the mean recovery period observed in each dose regimen, was seemed to be dose dependent. Recovery was smooth and uncomplicated in all the dose regimens. This was also supported by Babol et al. (1980) and Peshin et al. (1980) in camels who found that it took 115.8 minutes and 150 ± 56.9 minutes for recovery after intramuscular administration of xylazine at the dose rates of 0.25 mg/kg and 0.4 mg/kg body weight, respectively.
5.1.5 **Rectal temperature.**

The camel is able to save considerable amounts of energy by allowing its body temperature to rise during the day. In a camel watered daily the diurnal temperature variation is of the order 2°C which implies a heat storage of $4.2 \times 10^6$ J if the camel weighs 500 kg (Schmidt *et al.*, 1957a).

With the dose regimen of 0.1 mg/kg body weight, non-significant change in the reading of rectal temperature was observed throughout the period of study. Readings were showing fluctuating trend but remained within the physiological range.

Results obtained in the present study were in agreement with Fayed *et al.* (1989) in heifers and Reddy *et al.* (1991) in cattle after intramuscular administration of xylazine.

With 0.2 and 0.3 mg/kg body weight doses, there was a significant decrease in rectal temperature. This decrease in temperature occurred at the intervals from 0 to 2 hours and persisted up to 4 hours in post-administration period as compared with pre-administration levels.

Similar effect of xylazine on rectal temperature was found in buffaloes (Kumar and Singh, 1977; Peshin and Kumar, 1979), bovine pediatric (Kumar and Singh, 1979) and neonatal foals (Robertson *et al.*, 1990).
The increase in rectal temperature following xylazine administration has been reported in horses (Fessl, 1970), cattle (Hopkins, 1972), buffaloes (Mottelib et al., 1975 and Tantawy et al., 1982), yearling calves (Young, 1979) and cows (Jean et al., 1990).

The decrease in body temperature has been attributed to general sedation, inhibition of skeletal muscle movements and reduction in metabolic rate. In the present study significant change in rectal temperature with the dosage level of 0.2 mg/kg and 0.3 mg/kg body weight may be due to inhibition of skeletal muscle activity. A comparative greater decrease in animals undergoing surgery may be due to dissipation of heat from exposed viscera during surgery (Kumar et al., 1979).

5.1.6 Respiration rate.

With the dose regimens of 0.1 and 0.2 mg/kg body weight, non-significant change in the value of respiration rate was observed throughout the period of study.

While with the dose regimen of 0.3 mg/kg body weight respiration decreased significantly at the intervals from 2 to 4 hours after xylazine administration.

Significant decrease in respiration rate following intramuscular administration was observed in buffaloes (Kumar et al., 1976; Kumar and Singh, 1977 and Peshin and Kumar, 1979). The decrease in respiration rate after parenteral injection of xylazine have been reported in calves (Campbell et al.; 1970; Young, 1979 and Patel, 1991) and cattle (Kumar and Singh, 1976 and Fessl, 1990).

Kumar and Singh (1976 and 1977) reported that the inhibition of respiratory activity observed after xylazine administration lasted only during the period of marked sedation and it diminished as sedation lightened. This particular effect may be interpreted as a retention of resting value instead of existence of any specific inhibition of respiratory system. But Bollwahan et al. (1970) had attributed that decrease in respiration rate is due to depression of respiratory centre.

In the present study there was a mild to moderate sedation in the dosage levels of 0.2 and 0.3 mg/kg body weight. This was also advocated by Samy and Tantawy (1981) who reported that the reduction in respiratory rate may be due to sedative and hypnotic effect of xylazine.
5.1.7 Pulse rate

In the present study there was non-significant change in the value of pulse rate with the dose regimens of 0.1 and 0.3 mg/kg body weight throughout the period of study. But there was a transient fall in the pulse rate with these dose regimens.

While with the dose regimen of 0.2 mg/kg body weight pulse rate decreased significantly at the intervals from 0 to 4 hours after xylazine administration.

This is congruous with the findings of Mottelib and El-Gindhi (1975) in buffaloes, Waterman (1981) in calves, Tantawy et al. (1982) in buffaloes and Fayed et al. (1989) in heifers with intramuscular administration of xylazine. This may be a manifestation of depressant action of xylazine on cardiac pace maker as suggested by Schmitt et al. (1970) and Antonaccio et al. (1973). The subsequent withdrawal of Sympathetic tone of vascular system also conjoins this phenomenon due to xylazine administration as substantiated by Sanger et al. (1968).

5.2 HEMATOLOGICAL OBSERVATIONS

5.2.1 Haemoglobin (Hb).

Haemoglobin acts as a vehicle to supply oxygen to tissues. The major pathological effects of a low haemoglobin level is its threats to the transport of oxygen imposed by the diminution in the oxygen carrying capacity. During general anaesthesia there is vasodilatation leading to increase in the rate of haemodilution and this affects the Hb concentration (Bhatia et al., 1979).
In the present study there was non-significant change in the value of haemoglobin concentration with all the dose regimens, observed throughout the period of study. Results obtained in the present study were in agreement with Peshin et al. (1980) in camel with intramuscular administration of xylazine, and Singh et al. (1983) in cross-bred calves after intravenous administration of xylazine.

There was significant decrease in Hb concentration following intramuscular administration of xylazine in buffaloes (Fouad and Shokry, 1973), in white tailed deer (Presidente et al., 1973) and in cattle (Kumar and Singh, 1976).

Whereas, non-significant decrease in Hb concentration was observed in cattle (Goranov et al., 1971 and Eichner et al., 1979) and buffaloes (Peshin and Kumar, 1983) after parenteral administration of xylazine.

The decrease in Hb concentration after xylazine administration denoted dilution of blood and may have resulted from pooling of erythrocytes in the spleen as had been demonstrated with barbiturates and diazepam in goats (Monzally et al., 1972 and Kumar and Thurmon, 1979), Ketamine in sheep (Kumar et al., 1974) and barbiturate in cattle (Drasag, 1963). Since increase or decrease in the value of Hb depends on the size and number of circulating erythrocytes (Schalm, 1986), the non-significant decrease in the Hb concentration observed during present study may be due to decrease in total erythrocyte count.
5.2.2 Packed Cell Volume (PCV).

In the present study PCV decreased non-significantly at intervals from 0 to 4 hours after administration of xylazine with all the three dose regimens. This was substantiated by the findings of Peshin *et al.* (1980) in camels with intramuscular administration of xylazine.

In the present study, the decrease in PCV also tallied with findings of Kumar and Singh (1976) and Eichner *et al.* (1979) in cattle and Peshin and Kumar (1983) in buffaloes who reported PCV decrease after xylazine administration. Peshin *et al.* (1980) confirmed same decrease in PCV in dogs after xylazine administration.

On the other hand, contradictory reporting had been made by Presidente *et al.* (1973) in white tailed deer who observed significant drop in PCV after administration of etorphine and xylazine combination. Identical significant drop in PCV was also established by Bolbol *et al.* (1980) in dromedaries after xylazine administration.

The decrease in PCV after xylazine administration denoted dilution of blood and may have resulted from pooling of erythrocytes in the spleen leading to reduction in circulatory erythrocytes (Hanser *et al.*, 1983). Increase or decrease in the
volume of PCV depended on the size and number of circulating erythrocytes (Schalm, 1986). The non-significant decrease in PCV during anaesthesia in the present study could have been due to non-significant decrease in total erythrocyte count with the dose regimens of 0.1 and 0.3 mg/kg body weight and significant decrease with 0.2 mg/kg body weight.

5.2.3 Total Erythrocyte Count (TEC).

Total erythrocyte count was decreased significantly in the dose regimen of 0.2 mg/kg body weight at the intervals from 0 to 4 hours post-administration of xylazine.

This significant decrease was authenticated by Fouad and Shokry (1973), Mottelib and El-Gindhi (1975) in buffaloes, Kumar and Singh (1976) in cattle and Custer et al. (1977), Bolbol et al. (1980), Ali et al. (1989) in drome-daries with xylazine administration.

While with the dose regimens of 0.1 and 0.3 mg/kg body weight, non-significant decrease in TEC was observed throughout the period of this study. These findings were in conformation to results of Kumar et al. (1979) and Peshin et al. (1980) in dogs, Kumar and Singh (1979) in bovine pediatric, Peshin and Kumar (1983) in buffaloes and Peshin et al. (1980) in camels after parenteral administration of xylazine.
According to Hanser et al. (1938) drop in TEC may be due to splenic sequestration. Further Bhatia et al. (1979) emphasized vasodilation causing haemodilution with flow of interstitial fluid to blood vessels. However, O'Brien and Heath (1968) contravened their claim and constated that decrease in TEC could have been due to decline in the level of activity in sympathoadrenal system. This would have been followed by relaxation and expansion of the spleen. However, Steffey et al. (1976) reported decreased haematocrit value during halothane and halothane-nitrous oxide anaesthesia even in splenectomised dogs. They opined that in addition to splenic sequestration of erythrocytes, there might have been some other mechanism also.

5.2.4 Total Leucocyte Count (TLC).

Gradual decrease in TLC was observed at intervals from 0 to 4 hours and 0 to 2 hours in the dosage levels of 0.1, 0.2 and 0.3 mg/kg body weight, respectively but non-significant.

This non-significant decrease in TLC in the present study was also supported by Peshin et al. (1980) in camels following intramuscular administration of xylazine.

Peshin and Kumar (1983) had again observed the same, viz, slight reduction in leucocyte count in buffaloes after xylazine administration.
This decrease in leucocytes may be attributed to adrenocortical stimulation and subsequent effect of glucocorticoids on circulating neutrophils and lymphocytes (Schalm, 1986; Oyama et al., 1970 and Nara et al., 1979).

5.3 BIOCHEMICAL OBSERVATIONS:

5.3.1 Total Serum Protein.

In the dose regimens of 0.1 and 0.3 mg/kg body weight, non-significant change in the value of total serum protein was observed throughout the period of the present study.

This was substantiated by findings of Eichner et al. (1979) who reported similar findings in beef cattle following intravenous administration of xylazine. Peshin et al. (1983) also reported same findings in buffaloes following intramuscular administration of xylazine.

While with the dose regimen of 0.2 mg/kg body weight there was significant decrease in serum protein at interval of 2 hours post-administration of xylazine. Thereafter, there was non-significant increase in serum protein.

Such findings of significant decrease in serum protein was reported by Botelho (1977) in cattle following intramuscular injection of xylazine.
Short et al. (1972) had also concurred to such findings in total serum protein values ranging from 7.27 to 7.85 gm percent in horses.

The changes in the serum protein values are related to kidney function. A marginal increase in the values are possible whenever there is decreased renal flow and consequent decrease in glomerular filtration rate. This may happen due to altered haemodynamics, especially during anaesthesia. Further an increase in serum protein value is observed when muscle metabolism is affected.

Since, the changes in serum protein values were non-significant except at 2 hours with the dose regimen of 0.2 mg/kg body weight, it can be safely concluded that neither the kidney function, nor the muscle metabolism was affected in the animals in present study with epidural administration of xylazine in clinical cases of camels.

However, plasma protein concentration was found to decrease significantly with 15 minutes of halothane anaesthesia in dogs and monkeys (Steffey et al. 1976). The plasma protein during halothane anaesthesia in dogs had positive correlation with haematocrit, and negative correlation with plasma volume. The plasma volume in the anaesthetised dogs increased 30 to 50 percent above the normal, resulting into lowered plasma protein
levels. The changes observed in the protein values under the present study might have been due to the reasons postulated by Steffey et al. (1976).

5.3.2 Serum Glucose.

There was significant increase in the value of serum glucose in the dose regimens of 0.1, 0.2 and 0.3 mg/kg body weight at intervals from 2 to 24 hours, respectively following administration of xylazine.

Similar findings of significant rise in blood glucose level following xylazine anaesthesia have been reported in cattle (Goranov et al., 1971; Symonds, 1976; Kumar and Singh, 1976; Thurman et al., 1978; Eichner et al., 1979; Hsu, 1981; Patel, 1991 and More et al., 1993), buffaloes (Peshin and Kumar, 1983), sheep (Broachman, 1981 and Goranov et al., 1983), horses (Short et al., 1972 and Robertson et al., 1990), dogs (Kumar et al., 1979 and Peshin et al., 1980) and camels (Custer et al., 1977; Peshin et al., 1980 and Ali et al., 1989).

Hyperglycaemia due to toxic effect of anaesthesia on liver and increased secretion of adrenalin has been reported (Westbues and Fritsch, 1965 and Hall, 1976). The increased blood glucose level during either anaesthesia has been attributed to increased sympathetic activity, decrease in membrane transport of glucose, decrease glucose utilization, impaired insulin activity, decreased renal excretion and/or increased blood concentration of adrenocortical hormone (Greene, 1972).
All the stressors are believed to stimulate the hypothalamus and pituitary. The latter responds by increasing the secretion of ACTH which in turn induces the production of two important corticoids, the mineralo-corticoids, and glucocorticoids. In the event of stress, however, the secretion of ACTH stimulates a greater production of latter than the former. By virtue of their gluconeogenic action, the glucocorticoids contribute to hyperglycaemia. Consequent upon sympathetic stimulation attendant on stress, the production by catecholamines from adrenal medulla are also accelerated (Dikshit and Prasad, 1977). Xylazine is known to cause hyperglycaemia by increasing hepatic glucose production (Broachman, 1981).

Glucosuria and polyuria of short duration result from the hyperglycaemia (Knight, 1980).

5.3.3 Serum Chloride.

With all the three dose regimens, non-significant change, except at interval of 4 hours with the dose regimen of 0.3 mg/kg body weight, in the values of serum chloride was observed throughout the period of the present study.

Similar effect of xylazine on serum chloride was recorded by Peshin et al. (1980) in dogs, Peshin et al. (1983) in buffaloes and Ravikumar et al. (1992) in experimental calves.
It can, therefore, be concluded that the blood dilution has not been caused by water or electrolyte retention, but most probably by increased temporary migration of interstitial fluid to the vascular system. Similar findings were recorded by Fouad (1963) and Peshin et al. (1980). Ravikumar et al. (1992) reported that chloride levels declined following surgery which could be attributed to post-surgical anorexia leading to nutritional chloride deficiency.

5.3.4 Serum Sodium.

In all the three dose regimens values of serum sodium were found to be fluctuating with non-significant changes at different intervals after administration of xylazine. It was recorded maximum at the interval of 4 hours (154.5 ± 6.54) after administration of xylazine in the dose regimen of 0.1 mg/kg body weight.

Such non-significant changes, in the values of serum sodium in the present study, were also reported by Eichner et al. (1979) in beef cattle, Kumar and Thurmon (1979) in goats and Gasthuys et al. (1986) in mares following xylazine administration.

In the light of foregoing discussion it could, therefore, be corroborated that blood dilution has not been caused by water or electrolyte retention, but most probably by the increased
temporary migration of interstitial fluid to the vascular system. Similar findings were recorded by Fouad (1963) and Peshin et al. (1980).

5.3.5 Serum Potassium.

Potassium in blood is concentrated chiefly in erythrocytes. It maintains remarkable constant concentrations in whole blood, and plasma as reported by Adriani (1955). It increased during polycythaemia and decreased in anaemia. Both haemolysis and anoxaemia caused a rise in plasma potassium (Adriani, 1955). Possibility of inhibited tubular reabsorption due to depressed renal function during pentobarbital anaesthesia in dogs was put forward by Blake (1957) because of loss of normal consistent reciprocal relationship between Na⁺ and K⁺ excretion in urine.

Kumar and Thurmon (1974) reported a transient increase in K⁺ level due to carbon dioxide retention in sheep under ketamine anaesthesia. Premedication of atropine and acetylpromazine followed by ketamine anaesthesia did not significantly alter potassium level in sheep.

In the present study, there was gradual decrease in serum potassium observed in all the three dose regimens at intervals from 0 to 24 hours except at 4 hours in the dose regimen of 0.1 mg/kg body weight. In all the three dose regimens values of
serum potassium were found to be fluctuating with non-significant changes at different intervals after administration of xylazine.

Similarly, such claims of non-significant decrease in serum potassium of present study had been reported by Eichner et al. (1979) in beef cattle and Peshin et al. (1980) in dogs after xylazine and Kumar et al. (1979) in dogs after ketamine, xylazine administration.

It could be presumed that the blood dilution in this respect is not caused by water or electrolytes retention in present study with epidural administration of xylazine in clinical cases of camels. Similar findings were recorded by Fouad (1963).
SUMMARY
AND
CONCLUSIONS
6. SUMMARY AND CONCLUSIONS

Xylazine hydrochloride was used in eighteen clinical cases of camels having various surgical problems. The age of the camels ranged from 5 years to 12 years and weighing between 565 to 965 kg. All the camels were kept off feed and water for 24 hours prior to the administration of xylazine. Xylazine hydrochloride was administered epidurally at sacro-coccygeal space at the dose regimens of 0.1 mg/kg, 0.2 mg/kg and 0.3 mg/kg body weight. In first six clinical cases of camels xylazine at the dose rate of 0.1 mg/kg body weight, was administered epidurally. In another six cases, xylazine at the dose rate of 0.2 mg/kg body weight was administered likewise. In remaining six cases, xylazine at the dose rate of 0.3 mg/kg body weight was administered at the same site. The induction time, extent and degree of anaesthesia, duration of anaesthesia and recovery time were recorded in each camel.

The rectal temperature, respiration rate and pulse rate were recorded before administration of xylazine and at 0 hour (i.e. after onset of anaesthesia on tail), 2 hours, 4 hours and 24 hours after administration of xylazine. Blood samples were collected before and 0, 2, 4, and 24 hours after administration of xylazine. These samples were analysed for various haematological parameters viz., Haemoglobin (Hb), Packed cell volume (PCV), Total erythrocyte count (TEC) and Total leucocyte
count (TLC). Blood samples were also collected before and 0, 2, 4 and 24 hours after administration of xylazine. These samples were analysed for various biochemical parameters viz., total serum protein, serum glucose, serum chloride, serum sodium, serum potassium.

The mean induction period was observed to be 15 min., 5 min., and 3 min., in the dose regimen of 0.1 mg/kg, 0.2 mg/kg and 0.3 mg/kg body weight, respectively. Induction of anaesthesia was smooth and without any complication.

In first six clinical cases of 0.1 mg/kg body weight dose rate, the area of anaesthesia was found to be mild to moderate in tail region. The analgesia of parts other than tail was not appreciable in this dose regimen.

In another six cases in the dose rate of 0.2 mg/kg body weight, the surgical analgesia was observed in the region of tail, croup and anus. The degree of analgesia and muscle relaxation were better as compared with the dose rate of 0.1 mg/kg body weight. Moderate to mild degree of analgesia was also observed in the perineal, scrotal, sacral, lumbar, thoracic, hip, thigh and hock regions with the same dose regimen. In remaining six cases in the dose rate of 0.3 mg/kg body weight, the surgical analgesia was observed in the regions of tail, croup, anal, perineal and scrotal. Moderate to mild...
degree of analgesia was also observed in sheath, sacral, lumbar, thoracic, thigh, hip and hock regions in the same dose rate. The degree of analgesia and muscle relaxation were excellent as compared with the dose regimens of 0.2 mg/kg and 0.1 mg/kg body weight.

Duration of anaesthesia was observed to be 145 min., 225 min., and 377 min., in the dose rates of 0.1, 0.2 and 0.3 mg/kg body weight, respectively.

Recovery period was observed to be 160 min., 230 min., and 380 min., in the dose rates of 0.1, 0.2 and 0.3 mg/kg body weight, respectively after epidural injection.

Present study indicated that the induction period, extent and degree of anaesthesia, duration of anaesthesia and recovery period were dose dependent.

Salivation could not be observed throughout the period of sedation under the dose regimens of 0.1 and 0.2 mg/kg body weight. But the mean duration of salivation from mild to moderate degree was found to be $24.16 \pm 11.285$ min., in the dose regimen of 0.3 mg/kg body weight. After peak degree of sedation flow of salivation decreased gradually and it almost stopped at complete recovery.
The mean duration of sedation was observed to be 25.50 ± 14.244 min., 76.66 ± 20.723 min. and 206.66 ± 36.757 min. in the dose rates of 0.1, 0.2 and 0.3 mg/kg body weight, respectively.

With the dose rate of 0.1 mg/kg body weight, there was non-significant change in rectal temperature, pulse rate and respiration rate during this study. "Identically, with the dose rate of 0.2 mg/kg body weight, there was non-significant change in respiration rate. But with the same dose rate, there was significant change in rectal temperature and pulse rate at the intervals of 0 hour to 2 hours and 0 hour to 4 hours, respectively".

With the dose rate of 0.3 mg/kg body weight, there was non-significant change in pulse rate throughout the study. While with same dose rate, there was significant change in rectal temperature and respiration rate at the intervals from 2 hours to 4 hours, respectively.

With all the dose rates, there was non-significant change in Hb, PCV, and TLC. Similar findings had also been made with the dose rate of 0.1 and 0.3 mg/kg body weight that there was non-significant change in TEC. But, with the dose rate of 0.2 mg/kg body weight there was significant change in TEC at intervals from 0 hour to 4 hours.
With all the dose rates there was non-significant change in serum sodium and potassium during this study. With the dose rate of 0.1 mg/kg body weight total serum protein and serum chloride values were unaffected. Similarly, with the dose rate of 0.2 and 0.3 mg/kg body weight there was non-significant change in serum chloride and total serum protein from induction period till 24 hours, respectively. But a significant fluctuation in the values of serum protein and serum chloride, of course transient, occurred at 2 hours and 4 hours but returned to normal in the end.

The serum glucose level increased significantly from 2 to 24 hours, 0 to 24 hours and 2 to 4 hours after the administration of xylazine, epidurally in the dose rates of 0.1, 0.2 and 0.3 mg/kg body weight, respectively.

**CONCLUSIONS.**

By this study the author concluded that:

1. Xylazine hydrochloride was found to be very effective and safe anaesthetic agent for epidural anaesthesia in clinical cases of camels. It can be used in different doses for producing anaesthesia of suitable duration of areas caudal to lumbo-sacral junction. The severity of operation inquestion, can be combated by its potency.

2. Xylazine produced satisfactory analgesia and muscle relaxation with the dose rates of 0.2 and 0.3 mg/kg body
However, the degree of analgesia, muscle relaxation, and extent of anaesthesia were found to be dose dependent.

3. Epidural administration of xylazine induced from mild to moderate salivation in the dose rate of 0.3 mg/kg body weight.

4. The changes in rectal temperature, pulse rate and respiration rate returned to pre-administration level by 4 hours of administration without disturbing homeostatic condition of patients.

5. With all the dose rates, there was non-significant change in Hb and PCV values. Hence in anaemic patient, xylazine hydrochloride can be used as a safe epidural anaesthesia upto the dosage level of 0.3 mg/kg body weight for correcting surgical affections caudal to lumbo-sacral junction.

6. A significant increase in serum glucose level was observed with all the dose rates upto 24 hours except in the dose rate of 0.3 mg/kg body weight.

7. The recovery from epidural anaesthesia was smooth and uneventful in all the clinical cases of camels, thus avoiding post-anaesthetic trauma and injuries.
8. None of the accidents like regurgitation, tympany, retention of urine and ataxia of hind limb were observed throughout the study in these dose regimens.

9. The technique employed in the current study for epidural anaesthesia in clinical cases of camels was cumberless and potent.

10. The obstetrical procedures and surgical operations on tail, anus perineum and its adjacent parts and scrotum could be successfully performed under the dose rates of 0.2 and 0.3 mg/kg body weight.

11. Although, the onset of analgesia was prolonged but duration of analgesia was longer and fewer incidence of ataxia occurred following administration of xylazine, epidurally, when compared with lidocaine local anaesthetic.
BIBLIOGRAPHY
7. BIBLIOGRAPHY


caudal epidural analgesia in horses.


