ANAESTHESIA IN PIGEONS AND QUAILS USING KETAMINE AND XYLAZINE

By

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THESIS

Submitted in partial fulfilment of the
requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Surgery
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy, Thrissur

1994

DECLARATION

I hereby declare that the thesis entitled **"Anaesthesia in Pigeons and Quails Using Ketamine and Xylazine"** is a bonafide record of research work and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

Fabiana Lobo

Mannuthy,
26.2.1994.

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CERTIFICATE.

Certified that the thesis entitled **"Anaesthesia in Pigeons and Quails Using Ketamine and Xylazine"** is a record of research work done independently by **Kum. Lobo Fabiana**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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We, the undersigned members of the Advisory Committee of **Kum. Lobo Fabiana**, a candidate for the degree of Master of Veterinary Science in Surgery, agree that the thesis entitled **"Anaesthesia in Pigeons and Quails using Ketamine and Xylazine"** may be submitted by Kum. Lobo Fabiana, in partial fulfilment of the requirement for the degree.

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Introduction

INTRODUCTION

During the last two decades, the veterinary profession has shown an increasing interest in methods of sedation and anaesthesia in birds. This has primarily been the result of the development of new drugs suitable for the purpose and the increased demand for regular veterinary care of rare and valuable birds.

Anaesthetics can be administered in birds either orally, by the inhalation route or parenterally i.e. intramuscular, intravenous and intraperitoneal routes. Barbiturates such as sodium amytal (Fretz, 1932), sodium pentobarbital (Warren and Scott, 1935), equithesin (Gandal, 1956), sodium pentothal (Lee, 1953; Donovan, 1958), thiopentone sodium (Devanand, 1991) had been recommended for use in avian species.

Ketamine is one of the most frequently used anaesthetic drug in birds (Kittle, 1971; Borzoi, 1973; Mandelker, 1973; Heidenreich, 1978; Neal et al., 1981; Samour et al., 1984 and Devanand, 1991). Ketamine is associated with spontaneous movements and muscular rigidity and frequently is used with other anaesthetic drugs such as xylazine to overcome

these undesirable effects (Samour et al., 1984; Harvey et al., 1985; Petruzzi et al., 1988; Ludders et al., 1989). Xylazine when used alone or in combination with other drugs in birds, has been associated with respiratory depression and prolonged recovery from anaesthesia (Samour et al., 1984; Gonder and Barnes, 1989).

Pigeons (Columba livia) were selected for the present study because of their increasing popularity as pet birds in Kerala. Rearing Japanese quails (Coturnix coturnix japonica) has been taken up by Indian farmers on a large scale and is getting more and more popular as the years go by. These birds, because of their short generation interval, low feed and space requirement and high rate of egg laying, are very useful for research in the laboratory.

The present study was undertaken to assess the efficacy of (i) xylazine hydrochloride, (ii) ketamine hydrochloride and (iii) xylazine hydrochloride followed by ketamine hydrochloride, for anaesthetizing pigeons and quails.

Review of Literature

REVIEW OF LITERATURE

Fretz (1932) reported satisfactory general anaesthesia in birds using sodium amytal 0.006 to 0.010 g per lb bodyweight (0.1 g per ml) solution intravenously. Injections of 0.5-1.0 ml of this solution was adequate for birds ranging from 4-8 lb bodyweight.

Warren and Scott (1935) considered sodium-pentobarbital (Nembutal) as the most satisfactory general anaesthetic in poultry practice. Intravenous injections of 0.50-0.75 ml produced effective anaesthesia upto two hours.

Lee (1953) tried ether, chloroform, chloral hydrate, sodium pentothal and sodium amytal for anaesthetizing domestic fowls. Ether and chloroform were not safe for use in fowls due to sudden death from asphyxia. Chloral hydrate on oral administration produced general anaesthesia for 30 minutes and the anaesthetic effect persisted for 0.5, 2.5 and 4.5 hours in geese, ducks and chicken respectively. The anaesthetic dose of chloral hydrate was 0.10 to 0.15 g per lb bodyweight for geese, 0.125 to 0.150 g per lb bodyweight for ducks and 0.08 to 0.15 g per lb bodyweight for chicken. During anaesthesia the temperature showed a decrease of 1.0 to 2.4°C. In pigeons, chloral hydrate did not produce general anaesthesia but only depression and staggering gait. Intravenous injections of

sodium pentothal produced anaesthesia immediately or within a few minutes. The anaesthesia with sodium amytal lasted one to one and a half hours in geese and ducks, and 15 to 30 minutes in chicken and pigeons. In case of sodium pentothal it lasted for ,10 minutes in all fowls. For sodium pentothal adequate anaesthetic doses were 0.016 to 0.024 g per lb bodyweight for geese, ducks and chicken, and 0.008 to 0.024 g for pigeons. For sodium amytal, the doses were 0.006 to 0.010 g for geese, 0.008 to 0.024 g for ducks and 0.006 to 0.008 g for chicken and pigeons. The initial signs of anaesthesia were relaxation of all voluntary muscles and ruffled feathers. The loss of sensations and reflexes, the corneal reflex being the last to be abolished, were the indications of complete anaesthesia. The respiration was decreased in frequency and force. During recovery, the reflex of the neck muscles was the first to appear and gradually extended to the whole body. Muscular tremors, vomiting and staggering gait were always noticed.

Gandal (1956) used equithesin as an anaesthetic in domestic birds. In 122 clinical trials, on birds ranging from canaries to peacocks, safe, satisfactory surgical anaesthesia was readily induced by equithesin at a dose of 2.5 ml per kg bodyweight intramuscularly.

Donovan (1958) obtained satisfactory anaesthesia in birds (sparrows, canaries, chicken and parakeets) with

intramuscular injection of pentobarbital sodium (10 mg per ml), at a dose of 0.01 ml per 2.0 g bodyweight. The induction was smooth and in about two minutes all the birds closed their eyes. Surgical anaesthesia was satisfactory for about 30 minutes. Within 90 minutes after injection, birds were on their feet. Recovery was smooth and margin of safety was wide. There were no externally visible tissue reaction found at the site of injection.

Kittle (1971) found that general anaesthesia could be induced in experimental pigeons with a dose of 100 mg per lb (10 mg per 45 g) of ketamine given intramuscularly. Neither pharyngeal reflex nor salivation was apparent in the anaesthetized pigeons. Palpebral reflex could be elicited. Respiratory rate was reduced to 16 per minute and cardiac rate to 240 to 300 beats per minute. Laparotomy was performed on the anaesthetized birds. The pigeons were anesthetized five times during a four week period. There were no visible side effects or fatalities.

In order to examine a fractured wing of an adult red-tailed hawk he administered ketamine at the rate of 80 mg per lb bodyweight intramuscularly. The toe pinch reflex was barely evident 10 minutes after the drug was given. The hawk blinked frequently and there was profuse salivation. When 0.1 mg of atropine was given intramuscularly the salivation

was reduced but not stopped. Respiration was slightly depressed and a mild degree of tachycardia was present. The fracture site was manipulated without causing the bird any apparent discomfort. The hawk was standing three hours after being anaesthetized.

A green heron with a midshaft fracture of the tibiotarsal bone and a compound fracture of the humerus was given 25 mg of ketamine intramuscularly. Surgical anaesthesia was reached seven minutes later. Both fractures were repaired by open reduction. Neither profound respiratory depression nor salivation was noticed during the 15 minutes taken to complete the surgical repairs. The bird was alert two hours after being anaesthetized.

Ketamine was administered at the rate of 200 mg per lb body weight intramuscularly to repair a humeral fracture in a black vulture. Open reduction was performed to insert an intramedullary pin. Palpebral reflex persisted. The bird was standing three hours after being anaesthetized.

A screech owl with a fractured humerus was anaesthetized with 10 mg of ketamine given intramuscularly. The open reduction and repair took 30 minutes. An additional 10 mg of ketamine was needed about halfway through the repair as the owl began to show evidence of pain. Slight salivation

and a palpebral reflex were present. The owl was standing two hours after being anaesthetized. Increments of 10 mg into pigeons was administered during a 45 minute interval until satisfactory anaesthesia was induced without untoward effects. He recommended that small debilitated birds such as those with tumors, might be given 1 mg per 45 g at intervals until surgical anaesthesia was induced.

The effect of ketamine hydrochloride was studied by Borzoi (1973) in 22 birds. He suggested that 15 to 20 mg per kg bodyweight of ketamine hydrochloride administered intramuscularly was adequate for immobilization.

Levinger et al. (1973) tested the sedative action of Bay „Va 1470 (2-(2,6-Xylidino)-5,6-dihydro-4H-1, 3 thiazin hydrochloride. Manufactured also as Rompun) was tested on nine species of birds in about 90 experiments. The drug was injected intramuscularly in various doses in each bird. When doses upto 1.0 to 2.0 mg per kg bodyweight were used no changes in the behaviour of the birds were observed. When the doses were increased above 5.0 mg per kg bodyweight signs of depression were observed in all species of birds tested. The sedative effect of the drug changed into an anaesthetic one with increasing doses. The duration of activity was also proportional to the amount of drug injected. Doses upto 100 mg per kg bodyweight were tolerated and in no case did death

occur at doses lower than 200 mg per kg bodyweight. In the case of quails, the dose of the drug administered ranged from 10 to 200 mg per kg bodyweight and the onset of sedation from 2.0 to 10 min. The effect lasted for 30 to 60 min. The maximum duration was for 3.0 to 16 hours. In the case of pigeons, the dose ranged from 10 to 250 mg per kg bodyweight and the onset of sedation ranged from 5.0 to 10.0 minutes. The maximum duration was for 3.0 to 20 hours. The pigeons reacted differently to the drug. A deep sleep was rarely reached, although small doses caused a sedative effect. In most cases an opisthotony was observed which disappeared upon awakening from the depression. One of the pigeons died after the injection of 20 mg per kg bodyweight although the others survived with doses upto 100 mg per kg bodyweight. Side effects which were found to occur were erection of the feathers and relaxation of the wings. In all the birds studied, pathological changes were not observed on post mortem.

Mandelker (1973) reported ketamine hydrochloride to be a safe anaesthetic for use in parakeets. A dose of 0.05 mg per g to 0.10 mg per g administered intramuscularly was adequate. The induction time varied from a few seconds to 45 seconds. Clinical signs of anaesthesia following the administration of ketamine were typical of dissociative

anaesthesia. Muscle relaxation in parakeets was adequate at doses greater than 0.01 mg per g bodyweight. Respiration was deep and regular.

Boever and Wright (1975) reported that ketamine as a restraining and immobilizing drug had produced good anaesthesia for short diagnostic or minor surgical procedures in birds. In the studies conducted in more than 50 birds of 12 species ranging in weight from 15 g to 45 kg, it was concluded that the dose of ketamine per kg bodyweight for birds was inversely proportional to the weight of the birds. Heavier dose of ketamine produced deeper planes of anaesthesia. Hence with a low dose they could achieve restraint while a larger dose produced anaesthesia suitable for diagnostic or minor surgical procedures. In their experience, baseline figures for ketamine dosages administered intramuscularly were: birds weighing less than 100 g, 0.1 to 0.2 mg per g bodyweight; those weighing between 250 to 500 g, 0.05 to 0.10 mg per g bodyweight; those weighing more than 500 to 3000 g, 0.02 to 0.10 mg per g bodyweight and those weighing more than 3000 g, 0.05 mg per g bodyweight.

During the recovery period, frenzied wing flapping and head shaking were common.

Redig and Duke (1976) used a combination of ketamine hydrochloride and diazepam given intravenously to induce anaesthesia for various surgical procedures in 40 raptors. A dosage of 30 to 40 mg per kg bodyweight of ketamine hydrochloride and 1.0 to 1.5 mg per kg bodyweight of diazepam was satisfactory for diurnal raptors. Owls were more sensitive to the anaesthetic combination, necessitating greater care in anaesthetizing them.

Heidenreich (1978) injected ketamine hydrochloride at the rate of 30 mg per kg bodyweight intramuscularly in 78 diurnal birds of prey and 19 owls belonging to 25 species with various surgical conditions. During the onset of anaesthesia, mild excitement was observed in many birds, but not during deep anaesthesia. Excitement was also observed in half the birds on waking. Profuse salivation and vomiting of the crop contents occurred in some of the birds. All birds showed a skin response to stimulation. During anaesthesia the eyes were open and small movements of the head occurred.

Neal et al. (1981) administered ketamine hydrochloride at a dose of 75 to 150 mg per kg bodyweight intramuscularly to pigeons. This produced light anaesthesia with minimal changes to physiological functions and to acid-base status. Adverse side effects, other than salivation and moderate muscular rigidity were not noticed. The depth of anaesthesia was

adequate for manipulative clinical procedures and for minor surgical procedures.

McGrath et al. (1984) studied the dose response anaesthetic effect of ketamine in chicken. The study was conducted on 46 chicken with ketamine given intravenously at 12 dosages ranging from 1.0 to 160 mg per kg bodyweight. The median effective dose (ED50) for $\geq$ 15.0 minutes anaesthesia was 14 mg per kg bodyweight. The median lethal dose (LD50) was 67.9 mg per kg bodyweight. At doses less than 60 mg per kg bodyweight analgesia was not adequate for major surgical operations.

Samour et al. (1984) made a comparative study of the use of ketamine hydrochloride, xylazine hydrochloride and a combination of the two in 154 species of birds. Adequate surgical anaesthesia was achieved when ketamine hydrochloride was administered at a dose of 51.72 mg per kg bodyweight intramuscularly. The induction period was generally smooth with no excitement, except in large birds where manual restraint was necessary in order to avoid damage to the neck and legs. Incoordination, opisthotony and then relaxation were seen in almost all the birds within one to three minutes after injection. The maximum effect was maintained for about 35.0 $\pm$ 5.0 minutes. The eyes remained open, the palpebral reflex was present, and muscular relaxation was poor. In many

cases the effect was not adequate for surgical procedures of long duration. The recovery period was smooth only in a few cases. Lack of coordination, excitement, head shaking and wing flapping were noted in almost all the birds.

A single intramuscular injection of xylazine produced unsatisfactory results in all the cases where it was used. The induction time was prolonged and there were often signs of respiratory depression 10 to 15 minutes after injection. The drug always caused excitement and in some species of birds, convulsions. Surgical anaesthesia was never achieved and the recovery period was prolonged, sometimes extending for upto 12 hours.

The combination of ketamine and xylazine produced a better result in some species of birds than was the case with ketamine or xylazine alone. The induction period was longer than that for ketamine alone and lasted for upto 10 minutes after injection. In general induction was smooth. The maximum effect was maintained for about 45.0 $\pm$ 15 minutes. The eyes remained open, the palpebral reflex was present and muscular relaxation was good. The recovery period sometimes lasted for four hours but excitement was not seen.

Harvey et al. (1985) recommended 2.0 mg per kg bodyweight of ketamine combined with 2.0 mg per kg bodyweight

of xylazine hydrochloride administered by intramuscular injection to induce anaesthesia in three week old Leghorns.

Gandini et al. (1986) found that a mixture of ketamine and xylazine reduced considerably the quantity 16 of alphaxalone-alphadalone required. During anaesthesia, respiration rate was faster, heart rate was increased and corneal reflexes were present. Cloacal temperature showed a decrease of about 1°C, at an ambient temperature of 20°C. Recovery was smooth and as rapid as with steroid alone.

Christensen et al. (1987) compared the effects of diazepam in combination with equithesin, methomidate and ketamine in the domestic fowl. They found that the combination of 75 mg of ketamine per kg bodyweight intramuscularly followed by intravenous administration of 2.5 mg of diazepam per kg bodyweight did not result in the depth of anaesthesia required for surgical procedures.

Petruzzi et al. (1988) found that ketamine-xylazine combination given at a low dosage of 4.8 mg per kg bodyweight of ketamine and 0.38 mg per kg bodyweight of xylazine for griffon vultures and 18.43 mg per kg bodyweight of ketamine and 1.52 mg per kg bodyweight of xylazine for small raptors intramuscularly gave excellent sedation for the purpose of radiography and laparoscopy.

A method for repeated long-term restraint of young turkeys was developed by Gonder and Barnes (1989) using 15 mg per kg bodyweight of xylazine intramuscularly in 16 toms whose heads and body were covered with surgical stockinette secured with adhesive tape during a total of 229 restrained events. The birds were then restrained in dorsal recumbency for two, four or six hours daily for four days. Those restrained for six hours received an additional injection of 10 mg xylazine per kg bodyweight after three hours of restraint. Restrained events were uneventful in 215 cases, in 14, the turkeys struggled evidently or escaped their restraints. The mean body temperature of restrained birds declined during the first 150 minutes of restrained events and then stabilized.

Effects of ketamine, xylazine and a combination of ketamine and xylazine were studied in 12 male Pekin ducks by Ludders et al. (1989). Three arterial blood samples were collected every 15 minutes over a 45 minute period (control period). Following the control period, each duck was assigned at random to one of the three drug groups: ketamine 20 mg per kg bodyweight intravenously, xylazine 1.0 mg per kg bodyweight intravenously and ketamine 20 mg per kg bodyweight and xylazine 1 mg per kg bodyweight intravenously. Measurements were made at one, five, 10, 15, 30, 45, 60 and 90 minutes after drug administration. Cloacal temperatures were

significantly increased above control cloacal temperature at 90 minutes after the administration of ketamine and from 10 to 90 minutes after administration of ketamine plus xylazine. Results indicated that ketamine when given alone to ducks was not associated with pulmonary depression. There was drug associated respiratory depression after intravenous administration of xylazine or ketamine and xylazine.

Doolen and Jackson (1991) in their review suggested the use of ketamine at a dose of 10-30 mg per kg bodyweight intramuscularly or intravenously. On account of the lack of muscle relaxation and frequent excitatory recoveries it is often combined with xylazine. This provides muscle relaxation and enhances the level of analgesia. Ketamine is mixed at a 1:1 ratio by volume with xylazine. The dose is based on the ketamine dose with equal volume of xylazine added. This combination is considered to have a wide margin of safety, but the xylazine does provide a dose-related respiratory depressant effect and bradycardia. The agents take effect 3-5 minutes after intramuscular administration or 1-3 minutes after intravenous administration.

Devanand (1991) found that the intraperitoneal administration of ketamine hydrochloride at the rate of 100 mg per kg bodyweight, thiopentone sodium (2.5 per cent solution) at the rate of 15 mg per kg bodyweight, and ketamine

hydrochloride at the rate of 50 mg per kg bodyweight followed by thiopentone sodium at the rate of 7.5 mg per kg bodyweight resulted in satisfactory surgical plane of anaesthesia in chicken and ducks. For chicken, ketamine hydrochloride was preferred because of the comparatively least time for induction, prolonged duration of anaesthesia and quick recovery. Post anaesthetic complications were not found. In ducks the duration of anaesthesia was more, when ketamine was administered; but vigorous shaking of the head was seen during the period of recovery. Hence, for ducks, ketamine hydrochloride followed by thiopentone sodium was preferred because of the comparatively least time for induction and satisfactory duration of anaesthesia and recovery.

Matthews et al. (1991) induced anaesthesia in an 18-month-old female ostrich with 0.45 mg of xylazine per kg bodyweight and 25 mg of ketamine per kg bodyweight intramuscularly. Anaesthesia was maintained with isoflurane. Respiratory rate ranged from 25 to 40 per minute. The bird was judged to be in surgical plane of anaesthesia by loss of palpebral reflex, slowing of corneal reflex and lack of response to the surgical procedure. Recovery from anaesthesia was uncomplicated and the ostrich maintained sternal recumbency within 15 minutes after discontinuation of

isoflurane. The bird was able to stand unassisted 40 minutes later.

Cornick and Jensen (1992) evaluated several anaesthetic protocols used to facilitate intubation and anaesthetic maintenance with isoflurane in seven adult ostriches and one juvenile ostrich. Induction protocols included intravenous administration of xylazine and ketamine, intramuscular administration of carfentanil or xylazine/carfentanil and mask induction with isoflurane. They reported poor recovery with excessive uncontrollable attempts to stand following induction with xylazine and ketamine.

Materials and Methods

MATERIALS AND METHODS

Experimental birds

The study was conducted in 30 apparently healthy adult pigeons (Columba livia) of either sex weighing 120-260 g and 30 apparently healthy adult quails (Coturnix coturnix japonica) of either sex weighing 120-180 g. The birds were divided into two groups, Group I consisting of 30 pigeons and Group II consisting of 30 quails. Group I and II were further divided into three subgroups, viz., A, B and C each consisting of 10 birds, serially numbered from 1 to 10 viz.,

I A(1), A(2), A(3), A(4), A(5), A(6), A(7), A(8), A(9) and A(10)

I B(1), B(2), B(3), B(4), B(5), B(6), B(7), B(8), B(9) and B(10)

I C(1), C(2), C(3), C(4), C(5), C(6), C(7), C(8), C(9) and C(10)

II A(1), A(2), A(3), A(4), A(5), A(6), A(7), A(8), A(9) and A(10)

II B(1), B(2), B(3), B(4), B(5), B(6), B(7), B(8), B(9) and B(10)

II C(1), C(2), C(3), C(4), C(5), C(6), C(7), C(8), C(9) and C(10)

All the birds were maintained under identical conditions of feeding and management.

Preparation of birds

The birds were weighed before administering the anaesthetics. The site for intraperitoneal injection was the mid point between the cloaca and the keel bone (Fig.1). The feathers at the site were plucked and 70 per cent alcohol was applied.

Experiment

The birds were controlled on dorsal recumbency during the administration of the anaesthetics. The following drugs were administered.

Subgroup A : Xylazine* at the rate of 10 mg per kg bodyweight.

Subgroup B : Ketamine** at the rate of 150 mg per kg bodyweight.

Subgroup C : Xylazine at the rate of 5 mg per kg bodyweight followed by ketamine at the rate of 75 mg per kg bodyweight.

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* Xylaxin - Xylazine hydrochloride, 23.22 mg per ml (equivalent to 20 mg of xylazine) Indian Immunologicals, Hyderabad.

** Ketamin 50 - Ketamine hydrochloride, 50 mg per ml Themis Chemicals Ltd., Bombay.

During anaesthesia the birds were wrapped in a towel in order to keep them warm. The birds were fasted one hour prior to the experiment and were fed two hours after recovery from anaesthesia.

The following observations were recorded:

A. Clinical signs of anaesthesia
   1. Onset of anaesthesia
   2. Time for induction
   3. Duration of anaesthesia
   4. Duration of recovery
   5. Temperature and
   6. Respiration rate

B. Haemogram
   1. Total erythrocyte count
   2. Total leukocyte count
   3. Differential leukocyte count and
   4. Haemoglobin content

C. Assessment of anaesthetic effect by performing ingluviotomy

D. Side effects, if any

All the birds were kept under observation for five days after the administration of anaesthetics.

1. Onset of anaesthesia

Loss of balance, unsteadiness of head, ruffled feathers, dropping of wings, sitting posture, no voluntary movements, recumbency, and gradual abolition/sluggishness of pedal reflex were the symptoms suggestive of the onset of anaesthesia.

2. Time for induction

It was calculated as the time from the administration of the anaesthetics to the time of abolition/sluggishness of pedal reflex.

3. Duration of anaesthesia

It was calculated as the time interval between the time of abolition/sluggishness of pedal reflex and the time of reappearance of pedal reflex.

4. Duration of recovery

It was calculated as the time interval between the reappearance of pedal reflex and the time when the bird was able to walk normally.

5. Temperature was recorded using a thermometer inserted into the cloaca for one minute. Respiration rate was recorded by noting the movements of the thoracic wall.

The observations on temperature and respiration rate were recorded before administration and after administration at 15 minutes interval upto two and a half hours, at the third hour, 24th hour and on the fifth day.

B. Haemogram

Total erythrocyte and total leukocyte count were determined as per the method described by Sastri (1976). Differential leukocyte count was done with the Copper peroxidase method of Sato and Sekiya (1965). Haemoglobin content was estimated by Sahlis method (Schalm et al., 1975).

Blood sample was collected from the brachial vein which was raised by digital pressure, proximal to the site of collection using a scalp vein set (26 G, 27 G needle) attached to a 2 ml glass syringe.

C. Assessment of anaesthetic effect

The anaesthetic effect was assessed by performing ingluviotomy.

Surgical technique

The feathers at the base of the neck on the right side were plucked and the site prepared aseptically. A 2.5 cm long incision was made (Fig.2). The response to pain at the time

of incision, manipulation of wound edges and suturing were noted. The edges of the incision on the crop were sutured by simple interrupted sutures using silk. The skin edges were closed by simple interrupted sutures using silk and dressed the wound with Tr. benzoin seal (Fig. 3).

At the time of surgery, if the bird did not respond to pain it was considered as satisfactory anaesthesia while, slight response to pain as light anaesthesia.

D. Side effects

All the birds were sacrificed by exsanguination on the fifth day following administration of the anaesthetics and examined for gross lesions in the peritoneal cavity, and other organs.

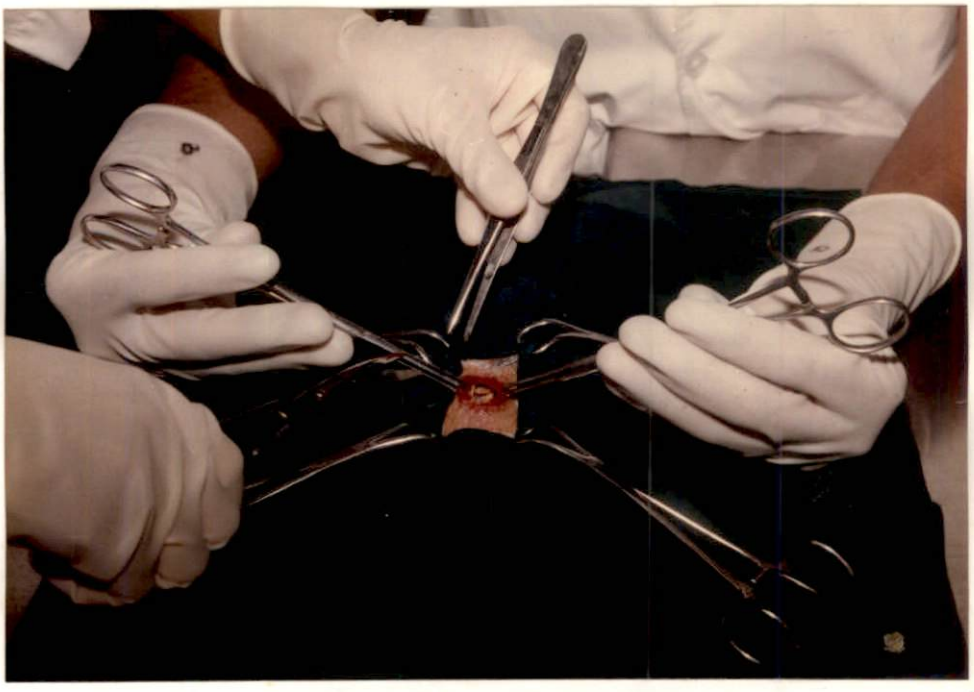
Statistical analysis

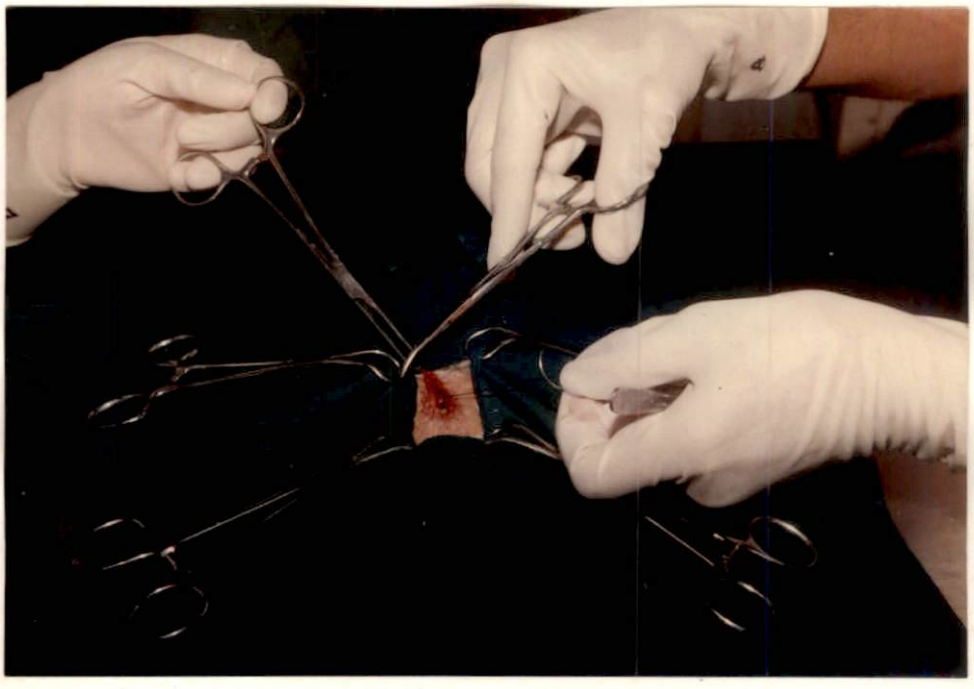
The data were analysed using students 't' test (Snedecor and Cocharan, 1967).

Fig.1 Site for intraperitoneal injection

Fig.2 Ingluviotomy - incised crop

Fig.3 Suturing - wall of the crop





Results

RESULTS

Group I Pigeons

Sub-group A

Xylazine was administered at the rate of 10 mg per kg bodyweight intraperitoneally to all the birds in the sub-group.

The bodyweight of the birds belonging to this sub-group was 141 ± 2.21 g.

The observations are presented in Tables 1 to 3.

A. Clinical signs of anaesthesia

1. Onset of anaesthesia

The characteristic symptoms at the onset of anaesthesia were loss of balance, ruffled feathers, droopiness, sitting posture, recumbency and sluggishness of pedal reflex.

2. Time for induction

The time for induction was 12.70 ± 0.40 min. and the induction was smooth and uneventful.

3. Duration of anaesthesia

The duration of anaesthesia was 47.70 ± 1.54 min. Clinical signs observed during the onset of anaesthesia became more pronounced during anaesthesia. Eyes were closed. Palpebral reflex, corneal reflex and third eyelid movement persisted. Pedal reflex was sluggish.

4. Duration of recovery

The duration of recovery was 164.80 ± 2.82 min.

Pedal reflex became more active followed by assuming the sitting posture. Then several attempts were made before they actually got up. Initially they could take a few steps that too with incoordination. Subsequently they walked normally.

The recovery was smooth and uneventful but prolonged.

5. Temperature

The temperature (°C) before administration was 43.80 ± 0.12 and after administration it was 42.10 ± 0.15 at 15 min., 41.50 ± 0.21 at 30 min., 40.85 ± 0.28 at 45 min., 40.00 ± 0.34 at 60 min., 39.75 ± 0.31 at 75 min., 39.85 ± 0.25 at 90 min., 39.80 ± 0.22 at 105 min., 40.00 ± 0.14 at 120 min., 39.90 ± 0.09 at 135 min., 40.00 ± 0.00 at 150 min., 39.90 ± 0.06 at

the third hour, 43.20 ± 0.18 at the 24th hour and 43.40 ± 0.15 on the fifth day.

There was significant (P <0.01) reduction in the temperature upto the third hour which became near normal by 24 hours.

6. Respiration rate

The respiration rate (per minute) before administration was 49.00 ± 1.17 and after administration it was 34.20 ± 3.10 at 15 min., 31.80 ± 2.79 at 30 min., 29.00 ± 2.80 at 45 min., 25.00 ± 2.15 at 60 min., 23.70 ± 1.80 at 75 min., 24.40 ± 1.35 at 90 min., 26.70 ± 1.35 at 105 min., 29.10 ± 1.73 at 120 min., 30.00 ± 1.91 at 135 min., 34.60 ± 2.22 at 150 min., 37.60 ± 1.39 at at the third hour 45.20 ± 0.41 at the 24th hour and 44.40 ± 0.68 on the fifth day.

There was significant (P <0.01) reduction in the respiration rate upto the third hour which became near normal by 24 hours.

B. **Haemogram**

1. Total erythrocyte count

The total erythrocyte count ($10^6/\mu l$) before administration was 3.62 ± 0.10 and after administration it was

3.37 ± 0.08 at 10 min., 3.52 ± 0.12 at the 24th hour and 3.59 ± 0.12 on the fifth day.

There was no significant variation in the count.

2. Total leukocyte count

The total leukocyte count ($10^3/\mu l$) before administration was 13.21 ± 0.04 and after administration it was 12.74 ± 0.04 at 10 min., 12.79 ± 0.09 at the 24th hour and 13.21 ± 0.05 on the fifth day.

The reduction was significant ($P<0.01$) at 10 min. and at the 24th hour and became near normal by the fifth day.

3. Differential leukocyte count

Lymphocyte count

The lymphocyte count (per cent) before administration was 67.70 ± 0.66 and after administration it was 62.70 ± 1.52 at 10 min., 62.90 ± 0.74 at the 24th hour and 67.10 ± 0.45 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and at 24 hours which became near normal by the fifth day.

Heterophil count

The heterophil count (per cent) before administration

was 28.10 ± 0.67 and after administration it was 31.20 ± 2.05 at 10 min., 27.00 ± 0.67 at the 24th hour and 26.10 ± 0.85 on the fifth day.

The variation in the count was not significant.

Eosinophil count

The eosinophil count (per cent) before administration was 2.20 ± 0.27 and after administration it was 5.30 ± 1.16 at 10 min., 8.50 ± 0.94 at the 24th hour and 6.10 ± 0.69 on the fifth day.

The increase in the count was significant ($P<0.01$) at 24 hours and on the fifth day.

Monocyte count

The monocyte count (per cent) before administration was 1.30 ± 0.34 and after administration it was 0.60 ± 0.25 at 10 min., 1.10 ± 0.29 at the 24th hour and 0.40 ± 0.28 on the fifth day.

The variation in the count was not significant.

Basophil count

The basophil count (per cent) before administration was 0.40 ± 0.15 and after administration it was 0.20 ± 0.12 at

10 min., 0.40 ± 0.28 at the 24th hour and 0.20 ± 0.12 on the fifth day.

The variation in the count was not significant.

4. Haemoglobin content

The haemoglobin content (dl %) before administration was 19.29 ± 0.19 and after administration it was 17.86 ± 0.18 at 10 min., 18.28 ± 0.13 at the 24th hour and 18.96 ± 0.12 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and at 24 hours which became near normal by the fifth day.

C. Assessment of anaesthetic effect

Anaesthesia was satisfactory since no response could be evinced on incising and suturing the skin and the wall of the crop.

D. Side effects

On examination of the peritoneal cavity no gross lesions could be observed at the site of intraperitoneal injection. The liver showed mild fatty changes. Focal areas of congestion were seen on the surface of the kidneys.

Table 1. Effects of intraperitoneal administration of xylazine in pigeons: time for induction, duration of anaesthesia and recovery

Bird No.	Bodyweight (g)	Quantity of drug administered (mg)	Time for induction (min)	Duration of anaesthesia (min)	Duration of recovery (min)
A_1	140	1.4	13	42	169
A_2	130	1.3	14	54	169
A_3	140	1.4	11	47	150
A_4	150	1.5	11	37	163
A_5	140	1.4	12	54	167
A_6	130	1.3	13	50	175
A_7	150	1.5	14	48	148
A_8	140	1.4	11	48	177
A_9	140	1.4	14	47	165
A_{10}	150	1.5	14	50	165
Mean $\pm$ S.E.	141.0 $\pm$ 2.21	1.40 $\pm$ 0.02	12.7 $\pm$ 0.40	47.7 $\pm$ 1.54	164.8 $\pm$ 2.82

Table 2. Effect of intraperitoneal administration of xylazine in pigeons: temperature and respiration rate (Mean ± S.E.), n =10

Intervals	Temperature (°C)	Respiration rate (min)
0 min	43.8 ± 0.12	49.0 ± 1.17**
15 min	42.1 ± 0.15**	34.2 ± 3.10**
30 min	41.5 ± 0.21**	31.8 ± 2.79**
45 min	40.85± 0.28**	29.0 ± 2.80**
60 min	40.0 ± 0.34**	25.0 ± 2.15**
75 min	39.75± 0.31**	23.7 ± 1.80**
90 min	39.85± 0.25**	24.4 ± 1.35**
105 min	39.8 ± 0.22**	26.7 ± 1.35**
120 min	40.0 ± 0.14**	29.1 ± 1.73**
135 min	39.9 ± 0.09**	30.0 ± 1.91**
150 min	40.0 ± 0.00**	34.6 ± 2.22**
Third hour	39.9 ± 0.06**	37.6 ± 1.39**
24th hour	43.2 ± 0.18	45.2 ± 0.41**
Fifth day	43.4 ± 0.15	44.4 ± 0.68

** Significant at 1 per cent level

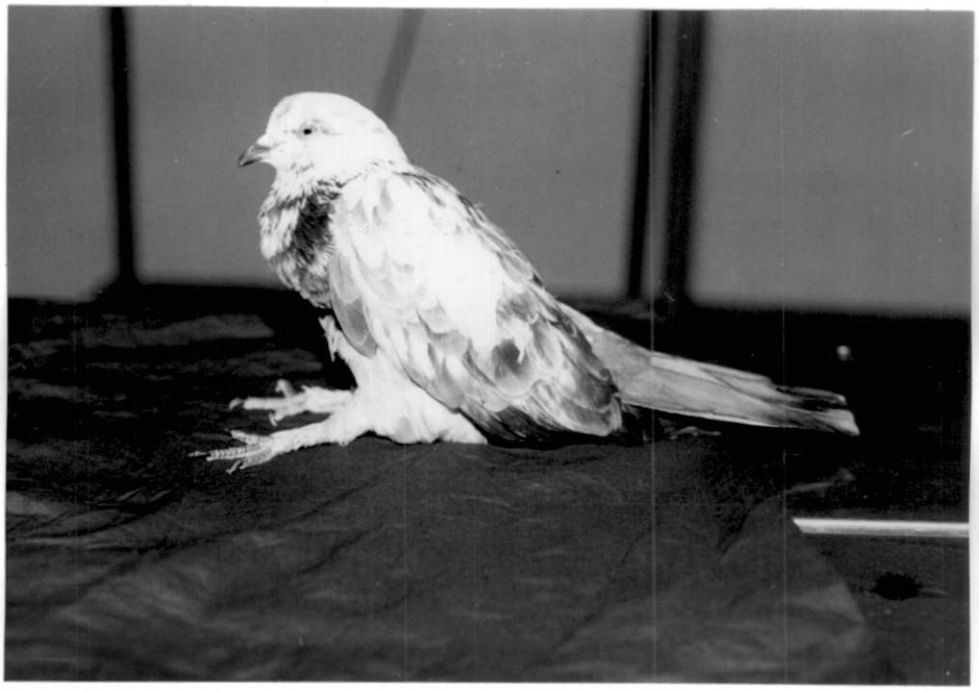
Table 3. Effect of intraperitoneal administration of xylazine in pigeons: Haemogram (Mean ± S.E.), n=10

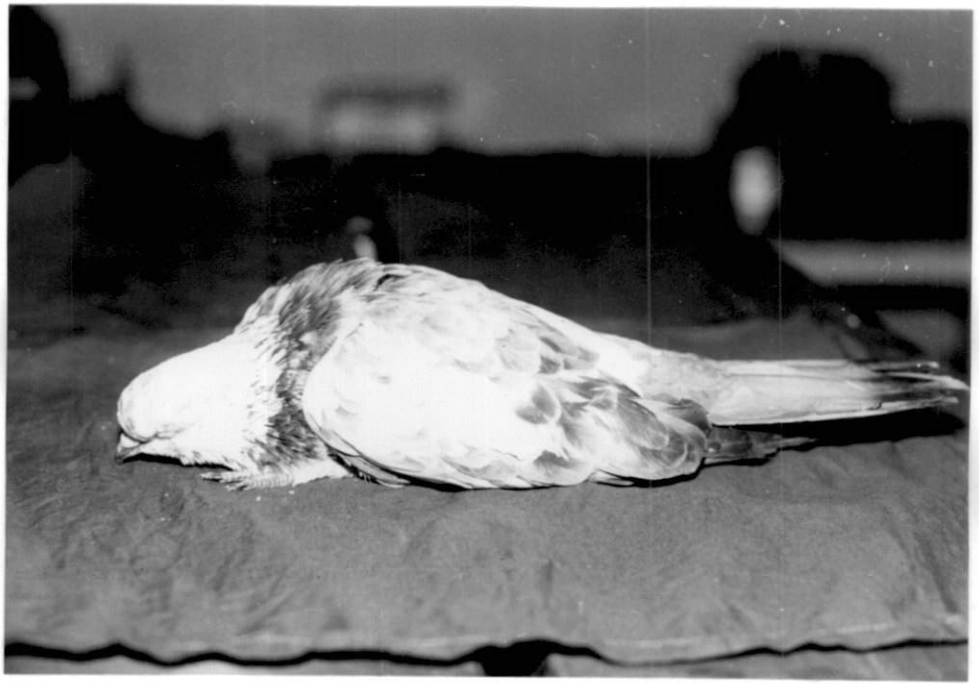
Parameters and units	Interval			
	0 min.	10 min.	24th hour	fifth day
Total erythrocyte count 10^6/ul	3.62 ± 0.10	3.37 ± 0.08	3.52 ± 0.12	3.59 ± 0.12
Total leukocyte count 10^3/ul	13.21 ± 0.04	12.74 ± 0.04**	12.79 ± 0.09**	13.21 ± 0.05
Lymphocyte (%)	67.70 ± 0.66	62.70 ± 1.52**	62.90 ± 0.74**	67.10 ± 0.45
Heterophil (%)	28.10 ± 0.67	31.20 ± 2.05	27.00 ± 0.67	26.10 ± 0.85
Eosinophil (%)	2.20 ± 0.27	5.30 ± 1.66	8.50 ± 0.94**	6.10 ± 0.69**
Monocyte (%)	1.30 ± 0.34	0.60 ± 0.25	1.10 ± 0.29	0.40 ± 0.28
Basophil (%)	0.40 ± 0.15	0.20 ± 0.12	0.40 ± 0.28	0.20 ± 0.12
Haemoglobin dl%	19.29 ± 0.19	17.86 ± 0.18**	18.28 ± 0.13**	18.96 ± 0.12

** Significant at 1 per cent level

Fig.4 Anaesthesia: sitting posture (xylazine)

Fig.5 Anaesthesia: sternal recumbency (xylazine)





Sub-group B

Ketamine hydrochloride was administered at the rate of 150 mg per kg bodyweight intraperitoneally to all the pigeons in this sub-group.

The bodyweight of the pigeons belonging to this sub-group was 176.00 ± 13.51 g.

The observations are presented in Tables 4 to 6.

A. Clinical signs of anaesthesia

1. Onset of anaesthesia

The characteristic symptoms at the onset of anaesthesia were loss of balance, ruffled feathers, fluttering of wings, dropping of wings, sitting posture, dropping of beak, torticollis, loss of righting reflex, recumbency and gradual abolition of pedal reflex.

2. Time for induction

The time for induction was 7.60 ± 0.42 min. The induction was smooth with no untoward signs.

3. Duration of anaesthesia

The duration of anaesthesia was 37.80 ± 2.88 min. Clinical signs observed during the onset of anaesthesia became

more pronounced during anaesthesia. Eyes were closed. Palpebral reflex, corneal reflex and third eyelid movement persisted. Pedal reflex was abolished.

4. Duration of recovery

The duration of recovery was 87.70 ± 2.98 min. During recovery, there was fluttering of wings and torticollis (Fig.6).

5. Temperature

The temperature (°C) before administration was 43.70 ± 0.14 and after administration it was 42.90 ± 0.06 at 15 min., 42.75 ± 0.07 at 30 min., 42.85 ± 0.21 at 45 min., 42.75 ± 0.23 at 60 min., 42.75 ± 0.25 at 75 min., 42.85 ± 0.26 at 90 min., 42.90 ± 0.25 at 105 min., 42.80 ± 0.27 at 120 min., 42.80 ± 0.27 at 135 min., 43.00 ± 0.23 at 150 min., 43.10 ± 0.20 at the third hour, 43.20 ± 0.18 at the 24th hour and 43.40 ± 0.15 on the fifth day.

There was significant ($P < 0.01$) reduction in the temperature upto the third hour which became near normal by 24 hours.

6. Respiration rate

The respiration rate (per minute) before administration was 51.20 ± 0.98 and after administration it

was 44.20 ± 1.03 at 15 min., 43.40 ± 1.40 at 30 min., 40.20 ± 1.49 at 45 min., 38.80 ± 2.21 at 60 min., 41.20 ± 1.96 at 75 min., 44.40 ± 1.81 at 90 min., 48.00 ± 2.15 at 105 min., 51.00 ± 2.01 at 120 min., 55.20 ± 1.49 at 135 min., 58.10 ± 1.47 at 150 min., 60.00 ± 1.35 at the third hour, 47.80 ± 1.14 at the 24th hour and 47.90 ± 1.00 on the fifth day.

There was significant ($P<0.01$) decrease upto 105 min., then it stabilized for a period of 30 min., and thereafter there was significant ($P<0.01$) increase upto the third hour which became near normal by the 24th hour.

B. Haemogram

1. Total erythrocyte count

The total erythrocyte count ($10^6/\mu l$) before administration was 3.63 ± 0.08 and after administration it was 3.35 ± 0.09 at 10 min., 3.34 ± 0.09 at the 24th hour and 3.49 ± 0.08 on the fifth day.

There was significant ($P<0.05$) reduction at 10 min. and at 24 hours and became near normal by the fifth day.

2. Total leukocyte count

The total leukocyte count ($10^3/\mu l$) before administration was 12.95 ± 0.14 and after administration it

was 12.35 ± 0.14 at 10 min., 12.61 ± 0.15 at the 24th hour and 12.68 ± 0.09 on the fifth day.

There was significant ($P < 0.01$) reduction at 10 min. and it became near normal by the fifth day.

3. Differential count

Lymphocyte count

The lymphocyte count (per cent) before administration was 68.20 ± 0.30 and after administration it was 66.90 ± 0.43 at 10 min., 65.10 ± 0.76 at the 24th hour and 67.30 ± 0.73 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min., and at 24 hours and it became near normal by the fifth day.

Heterophil count

The heterophil count (per cent) before administration was 28.10 ± 0.33 and after administration it was 27.30 ± 0.61 at 10 min., 25.20 ± 0.68 at the 24th hour and 26.60 ± 0.79 on the fifth day.

There was significant ($P<0.01$) reduction at the 24th hour which became near normal by the fifth day.

Eosinophil count

The eosinophil count (per cent) before administration was 2.30 ± 0.31 and after administration it was 3.70 ± 0.73 at 10 min., 4.50 ± 0.72 at the 24th hour and 3.80 ± 0.73 on the fifth day.

There was significant ($P<0.05$) increase at the 24th hour which became near normal by the fifth day.

Monocyte count

The monocyte count (per cent) before administration was 1.10 ± 0.26 and after administration it was 0.90 ± 0.22 at 10 min., 2.00 ± 0.34 at the 24th hour and 0.70 ± 0.31 on the fifth day.

The variation in the count was not significant.

Basophil count

The basophil count (per cent) before administration was 0.30 ± 0.14 and after administration it was 0 at 10 min., 0.20 ± 0.18 at the 24th hour and 0.30 ± 0.14 on the fifth day.

The variation in the count was not significant.

4. Haemoglobin content

The haemoglobin content (dl %) before administration was 15.39 ± 0.25 and after administration it was 13.84 ± 0.31 at 10 min., 14.52 ± 0.24 at 24 hours and 15.12 ± 0.29 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min and at 24 hours and it became near normal by the fifth day.

C. Assessment of anaesthetic effect

Anaesthesia was satisfactory since no response could be evinced on incising and suturing the skin and the wall of the crop.

D. Side effects

On examination of the peritoneal cavity no gross lesions could be observed at the site of intraperitoneal injection. Mild fatty changes were observed in the liver. Areas of mild congestion were seen on the surface of the kidneys.

Table 4. Effects of intraperitoneal administration of ketamine hydrochloride in pigeons: time for induction, duration of anaesthesia and recovery

Bird No.	Bodyweight (g)	Quantity of drug administered (mg)	Time for induction (min)	Duration of anaesthesia (min)	Duration of recovery (min)
B_1	260	39	7	38	88
B_2	200	30	8	40	87
B_3	140	21	7	32	80
B_4	140	21	7	28	90
B_5	140	21	8	31	92
B_6	240	36	11	44	75
B_7	180	27	6	54	73
B_8	140	21	8	52	90
B_9	140	21	8	27	95
B_{10}	180	27	6	32	107
Mean $\pm$ S.E.	176 $\pm$ 13.51	26.4 $\pm$ 2.02	7.6 $\pm$ 0.42	37.8 $\pm$ 2.88	87.7 $\pm$ 2.98

Table 5. Effect of intraperitoneal administration of ketamine hydrochloride in pigeons: temperature and respiration rate (Mean ± S.E.), n =10

Intervals	Temperature (°C)	Respiration rate (min)
0 min	43.7 ± 0.14	51.2 ± 0.98
15 min	42.9 ± 0.06**	44.2 ± 1.03**
30 min	42.75± 0.07**	43.4 ± 1.40**
45 min	42.85± 0.21**	40.2 ± 1.49**
60 min	42.75± 0.23**	38.8 ± 2.21**
75 min	42.75± 0.25**	41.2 ± 1.96**
90 min	42.85± 0.26**	44.4 ± 1.81**
105 min	42.9 ± 0.25**	48.0 ± 2.15**
120 min	42.8 ± 0.27**	51.0 ± 2.01
135 min	42.8 ± 0.27**	55.2 ± 1.49
150 min	43.0 ± 0.23**	58.1 ± 1.47**
Third hour	43.1 ± 0.20**	60.0 ± 1.35**
24th hour	43.2 ± 0.18	47.8 ± 1.14
Fifth day	43.4 ± 0.15	47.9 ± 1.00

** Significant at 1 per cent level

Table 6. Effect of intraperitoneal administration of ketamine hydrochloride in quails: Haemogram (Mean ± S.E.), n=10

Parameters and units	Interval			
	0 min.	10 min.	24th hour	fifth day
Total erythrocyte count 10^6/ul)	3.89 ± 0.04	3.53 ± 0.05**	3.70 ± 0.04**	3.86 ± 0.04
Total leukocyte count 10^3/ul	22.79 ± 0.28	21.26 ± 0.18**	22.11 ± 0.30	22.81 ± 0.29
Lymphocyte (%)	75.90 ± 0.51	71.30 ± 0.61**	72.50 ± 0.57	74.20 ± 0.57**
Heterophil (%)	23.60 ± 0.37	26.40 ± 0.63**	23.60 ± 0.83	23.50 ± 0.53
Eosinophil (%)	0.50 ± 0.21	1.60 ± 0.35**	3.90 ± 0.60**	2.20 ± 0.18**
Monocyte (%)	0.20 ± 0.12	0.60 ± 0.15	0.50 ± 0.21	0.30 ± 0.14
Basophil (%)	0	0.20 ± 0.12	0	0.10 ± 0.09
Haemoglobin dl%	14.78 ± 0.24	12.84 ± 0.30**	13.92 ± 0.24**	14.74 ± 0.18

** Significant at 1 per cent level

Fig.6 Anaesthesia: torticollis (ketamine hydrochloride)

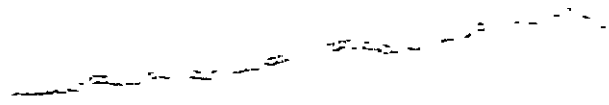


Fig.7 Anaesthesia: sitting posture (ketamine hydrochloride)

Fig.8 Anaesthesia: sternal recumbency (ketamine hydrochloride)

Fig.9 Anaesthesia: lateral recumbency (ketamine hydrochloride)

Sub-group C

Xylazine at the rate of 5 mg per kg bodyweight followed by ketamine hydrochloride at the rate of 75 mg per kg bodyweight were administered intraperitoneally to all the pigeons in the sub-group.

The bodyweight of the pigeons belonging to this sub-group was 140.00 ± 4.69 g.

The observations are presented in Tables 7 to 9.

A. Clinical signs of anaesthesia

1. Onset of anaesthesia

The characteristic symptoms at the onset of anaesthesia were loss of balance, ruffled feathers, fluttering of wings, dropping of wings, sitting posture, dropping of beak, torticollis, loss of righting reflex, recumbency and gradual abolition of pedal reflex.

2. Time for induction

The time for induction was 6.80 ± 0.34 min. The induction was smooth with no untoward signs.

3. Duration of anaesthesia

The duration of anaesthesia was 62.00 ± 1.15 min.

Clinical signs observed during the onset of anaesthesia became more pronounced during anaesthesia. Eyes were closed. Palpebral reflex, corneal reflex and third eyelid movement persisted. Pedal reflex was abolished.

4. Duration of recovery

The duration of recovery was 85.10 ± 2.72 min. The recovery was smooth and uneventful.

5. Temperature

The temperature (°C) before administration was 43.20 ± 0.18 and after administration it was 41.5 ± 0.29 at 15 min., 40.85 ± 0.40 at 30 min., 40.55 ± 0.47 at 45 min., 40.20 ± 0.43 at 60 min., 39.85 ± 0.40 at 75 min., 39.50 ± 0.38 at 90 min., 39.10 ± 0.41 at 105 min., 38.55 ± 0.37 at 120 min., 38.35 ± 0.35 at 135 min., 38.55 ± 0.32 at 150 min., 38.90 ± 0.30 at the third hour, 43.30 ± 0.20 at the 24th hour and 43.50 ± 0.15 on the fifth day.

There was significant ($P < 0.01$) reduction in the temperature upto the third hour which became near normal by 24 hours.

6. Respiration rate

The respiration rate (per minute) before

administration was 50.00 ± 1.20 and after administration it was 39.80 ± 1.21 at 15 min., 34.80 ± 1.86 at 30 min., 30.40 ± 2.03 at 45 min., 28.10 ± 1.61 at 60 min., 25.80 ± 1.90 at 75 min., 23.80 ± 1.45 at 90 min., 23.70 ± 1.07 at 105 min., 24.00 ± 1.32 at 120 min., 26.80 ± 1.39 at 135 min., 32.60 ± 1.16 at 150 min., 37.60 ± 0.73 at the third hour, 46.00 ± 0.56 at the 24th hour and 46.00 ± 0.84 on the fifth day.

There was significant ($P<0.01$) reduction in respiration upto the third hour which became near normal by the fifth day.

B. Haemogram

1. Total erythrocyte count

The total erythrocyte count ($10^6/\mu l$) before administration was 3.88 ± 0.03 and after administration it was 3.43 ± 0.06 at 10 min., 3.58 ± 0.05 at the 24th hour and 3.85 ± 0.03 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and at 24 hours which became near normal by the fifth day.

2. Total leukocyte count

The total leukocyte count ($10^3/\mu l$) before administration was 13.12 ± 0.06 and after administration it

was 12.46 ± 0.07 at 10 min., 12.77 ± 0.03 at the 24th hour and 12.99 ± 0.05 on the fifth day.

There was significant ($P < 0.01$) reduction at 10 min., and 24 hours which became near normal by the fifth day.

3. Differential count

Lymphocyte count

The lymphocyte count (per cent) before administration was 67.80 ± 0.36 and after administration it was 60.40 ± 0.60 at 10 min., 62.40 ± 1.05 at the 24th hour and 65.60 ± 1.26 on the fifth day.

There was significant ($P<0.05$) reduction at 10 min. and 24 hours which became near normal by the fifth day.

Heterophil count

The heterophil count (per cent) before administration was 26.90 ± 0.49 and after administration it was 31.60 ± 0.32 at 10 min., 27.30 ± 1.00 at the 24th hour and 26.30 ± 1.94 on the fifth day.

There was significant ($P < 0.01$) increase at 10 min., which became near normal by 24 hours.

Eosinophil count

The eosinophil count (per cent) before administration was 2.50 ± 0.49 and after administration it was 6.80 ± 0.48 at 10 min., 9.10 ± 0.38 at the 24th hour and 7.20 ± 0.94 on the fifth day.

There was significant ($P<0.01$) increase at 10 min., 24 hours and fifth day.

Monocyte count

The monocyte count (per cent) before administration was 2.20 ± 0.41 and after administration it was 0.80 ± 0.23 at 10 min., 0.80 ± 0.30 at the 24th hour and 0.70 ± 0.28 on the fifth day.

There was significant ($P<0.05$) reduction at 10 min., 24 hours and on the fifth day.

Basophil count

The basophil count (per cent) before administration was 0.50 ± 0.15 and after administration it was 0.10 ± 0.09 at 10 min., 0.30 ± 0.20 at the 24th hour and 0.10 ± 0.09 on the fifth day.

There was significant ($P<0.05$) reduction at 10 min. and on the fifth day.

4. Haemoglobin content

The haemoglobin content (dl%) before administration was 18.20 ± 0.56 and after administration it was 16.38 ± 0.59 at 10 min., 17.06 ± 0.54 at 24 hours and 17.74 ± 0.52 on the fifth day.

There was significant ($P<0.01$) decrease at 10 min. which became near normal by 24 hours.

C. Assessment of anaesthetic effect

Anaesthesia was satisfactory since no response could be evinced on incising and suturing the skin and the wall of the crop.

D. Side effects

On examination of the peritoneal cavity there were no gross lesions at the site of intraperitoneal injection. The liver showed areas of mild fatty changes. Focal areas of congestion were observed on the surface of the kidneys.

Table 7. Effects of intraperitoneal administration of xylazine followed by ketamine hydrochloride in pigeons: time for induction, duration of anaesthesia and recovery

Bird No.	Bodyweight (g)	Quantity of drug administered (mg)		Time for induction (min)	Duration of anaesthesia (min)	Duration of recovery (min)
		Xylazine	Ketamine			
C_1	160	0.8	12	6	63	81
C_2	140	0.7	10.5	5	65	85
C_3	120	0.6	9	6	70	91
C_4	160	0.8	12	8	57	106
C_5	140	0.7	10.5	8	59	77
C_6	130	0.65	9.75	7	62	73
C_7	130	0.65	9.75	6	60	82
C_8	160	0.8	12	8	65	81
C_9	120	0.6	9	8	59	86
C_{10}	140	0.7	10.5	6	60	89
Mean $\pm$ S.E.	140 $\pm$ 4.69	0.7$\pm$0.02	10.5$\pm$0.35	6.8 $\pm$ 0.34	62 $\pm$ 1.15	85.1 $\pm$ 2.72

Table 8. Effect of intraperitoneal administration of xylazine followed by ketamine hydrochloride in pigeons: temperature and respiration rate (Mean ± S.E.), n =10

Intervals	Temperature (°C)	Respiration rate (min)
0 min	43.2 ± 0.18	50.0 ± 1.20
15 min	41.5 ± 0.29**	39.8 ± 1.21**
30 min	40.85± 0.40**	34.8 ± 1.86**
45 min	40.55± 0.47**	30.4 ± 2.03**
60 min	40.2 ± 0.43**	28.1 ± 1.61**
75 min	39.85± 0.40**	25.8 ± 1.90**
90 min	39.50± 0.38**	23.8 ± 1.45**
105 min	39.1 ± 0.41**	23.7 ± 1.07**
120 min	38.55± 0.37**	24.0 ± 1.32**
135 min	38.35± 0.35**	26.8 ± 1.39**
150 min	38.55± 0.32**	32.6 ± 1.16**
Third hour	38.9 ± 0.30**	37.6 ± 0.73**
24th hour	43.3 ± 0.20	46.0 ± 0.56
Fifth day	43.5 ± 0.15	46.0 ± 0.84

** Significant at 1 per cent level

Table 9. Effect of intraperitoneal administration of xylazine followed by ketamine hydrochloride in pigeons: Haemogram (Mean ± S.E.), n=10

Parameters and units	Interval			
	0 min.	10 min.	24th hour	fifth day
Total erythrocyte count 10^6/ul)	3.88 ± 0.03	3.43 ± 0.06**	3.58 ± 0.05**	3.85 ± 0.03
Total leukocyte count 10^3/ul	13.12 ± 0.06	12.46 ± 0.07**	12.77 ± 0.03**	12.99 ± 0.05
Lymphocyte (%)	67.80 ± 0.36	60.40 ± 0.60**	62.40 ± 1.05**	65.60 ± 1.26
Heterophil (%)	26.90 ± 0.49	31.60 ± 0.32**	27.30 ± 1.00	26.30 ± 1.94
Eosinophil (%)	2.50 ± 0.49	6.80 ± 0.48**	9.10 ± 0.38**	7.20 ± 0.94**
Monocyte (%)	2.20 ± 0.41	0.80 ± 0.23*	0.80 ± 0.30*	0.70 ± 0.28*
Basophil (%)	0.50 ± 0.15	0.10 ± 0.09*	0.30 ± 0.20	0.10 ± 0.09*
Haemoglobin dl%	18.20 ± 0.56	16.38 ± 0.59**	17.06 ± 0.54	17.74 ± 0.52

** Significant at 1 per cent level

* Significant at 5 per cent level

Fig.10 Anaesthesia: sitting posture (xylazine-ketamine combination)

Fig.11 Anaesthesia: Sternal recumbency (xylazine-ketamine combination)

Fig.12 Anaesthesia: lateral recumbency (xylazine-ketamine combination)

Group II Quails

Sub-group A

Xylazine was administered at the rate of 10 mg per kg bodyweight intraperitoneally to all the quails in this sub-group.

The bodyweight of the birds belonging to this sub-group was 145.00 ± 3.05 g.

The observations are presented in Tables 10 to 12.

A. Clinical signs of anaesthesia

1. Onset of anaesthesia

The characteristic symptoms at the onset of anaesthesia were loss of balance, ruffled feathers, droopiness, dropping of wings, sitting posture, recumbency and sluggishness of pedal reflex.

2. Time for induction

The time for induction was 13.10 ± 0.43 min., and the induction was smooth.

The birds remained with the keel bone touching the floor, the hock stretched and the vent raised for a minute or two before assuming sternal recumbency (Fig.13).

3. Duration of anaesthesia

The duration of anaesthesia was 80.40 ± 1.96 min. Clinical signs observed during the onset of anaesthesia became more pronounced during anaesthesia. Eyes were closed. Palpebral reflex, corneal reflex and third eyelid movement were present. Pedal reflex was sluggish.

4. Duration of recovery

The duration of recovery was 99.90 ± 5.70 min. The recovery was smooth and uneventful but prolonged.

5. Temperature

The temperature (°C) before administration was 42.70 ± 0.14 and after administration it was 40.50 ± 0.25 at 15 min., 39.55 ± 0.33 at 30 min., 38.00 ± 0.47 at 45 min., 37.70 ± 0.47 at 60 min., 37.05 ± 0.42 at 75 min., 36.75 ± 0.39 at 90 min., 36.60 ± 0.29 at 105 min., 36.35 ± 0.31 at 120 min., 36.25 ± 0.28 at 135 min., 36.45 ± 0.39 at 150 min., 36.80 ± 0.36 at the third hour, 43.30 ± 0.14 at the 24th hour and 43.30 ± 0.20 on the fifth day.

There was significant ($P<0.01$) reduction in the temperature upto the third hour which became near normal by 24 hours.

6. Respiration rate

The respiration rate (per minute) before administration was 47.40 ± 1.52 and after administration it was 18.40 ± 1.79 at 15 min., 18.40 ± 0.79 at 30 min., 18.60 ± 1.97 at 45 min., 21.70 ± 1.94 at 60 min., 25.00 ± 1.45 at 75 min., 27.60 ± 1.51 at 90 min., 30.10 ± 1.26 at 105 min., 33.80 ± 0.99 at 120 min., 36.80 ± 0.64 at 135 min., 40.00 ± 0.74 at 150 min., 41.50 ± 0.47 at the third hour 46.40 ± 0.83 at the 24th hour and 45.00 ± 0.70 on the fifth day.

There was significant ($P<0.01$) reduction in the respiration rate upto the third hour which became near normal by 24 hours.

B. Haemogram

1. Total erythrocyte count

The total erythrocyte count ($10^6/\mu l$) before administration was 3.84 ± 0.04 and after administration it was 3.40 ± 0.03 at 10 min., 3.63 ± 0.04 at the 24th hour and 3.80 ± 0.04 on the fifth day.

There was significant ($P<0.01$) decrease at 10 min. and at 24 hours which became near normal by the fifth day.

2. Total leukocyte count

The total leukocyte count ($10^3/\mu l$) before administration was 22.43 ± 0.56 and after administration it was 20.93 ± 0.46 at 10 min., 21.44 ± 0.42 at the 24th hour and 22.41 ± 0.46 on the fifth day.

The variation in the count was not significant.

3. Differential count

Lymphocyte count

The lymphocyte count (per cent) before administration was 75.70 ± 0.47 and after administration it was 71.20 ± 0.44 at 10 min., 72.60 ± 0.40 at the 24th hour and 74.50 ± 0.62 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and at 24 hours which became near normal by the fifth day.

Heterophil count

The heterophil count (per cent) before administration was 22.50 ± 0.49 and after administration it was 26.70 ± 0.56 at 10 min., 21.50 ± 0.40 at the 24th hour and 22.00 ± 0.58 on the fifth day.

There was significant ($P<0.01$) increase at 10 min. which then became near normal by 24 hours.

Eosinophil count

The eosinophil count (per cent) before administration was 0.70 ± 0.14 and after administration it was 0.80 ± 0.18 at 10 min., 4.90 ± 0.22 at the 24th hour and 2.60 ± 0.32 on the fifth day.

The increase in the count was significant ($P<0.01$) at the 24th hour and on the fifth day.

Monocyte count

The monocyte count (per cent) before administration was 0.60 ± 0.28 and after administration it was 0.60 ± 0.28 at 10 min., 0.60 ± 0.15 at the 24th hour and 0.90 ± 0.26 on the fifth day.

The variation in the count was not significant.

Basophil count

The basophil count (per cent) before administration was 0.50 ± 0.15 and after administration it was 0.30 ± 0.14 at 10 min., 0.30 ± 0.20 at the 24th hour and 0.40 ± 0.15 on the fifth day.

The variation in the count was not significant.

4. Haemoglobin content

The haemoglobin content (dl%) before administration was 14.82 ± 0.19 and after administration it was 12.82 ± 0.25 at 10 min., 14.14 ± 0.28 at the 24th hour and 14.76 ± 0.16 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. which became near normal by 24 hours.

C. Assessment of anaesthetic effect

There was light anaesthesia. No responses were evinced on incising and suturing the skin and the wall of the crop but for slight body movements on manipulating the crop.

D. Side effects

On examination of the peritoneal cavity no gross lesions could be observed at the site of intraperitoneal injection. The liver showed mild fatty changes. Focal areas of congestion were seen on the surface of the kidneys.

Table 10. Effects of intraperitoneal administration of xylazine in quails: time for induction, duration of anaesthesia and recovery

Bird No.	Bodyweight (g)	Quantity of drug administered (mg)	Time for induction (min)	Duration of anaesthesia (min)	Duration of recovery (min)
A_1	156	1.56	14	75	75
A_2	150	1.5	13	80	106
A_3	128	1.28	15	87	120
A_4	156	1.56	12	85	60
A_5	142	1.42	11	79	100
A_6	132	1.32	14	67	97
A_7	140	1.4	15	87	113
A_8	156	1.56	13	75	106
A_9	140	1.4	11	83	103
A_{10}	150	1.5	13	86	119
Mean $\pm$ S.E.	145 $\pm$ 3.05	1.45 $\pm$ 0.03	13.1 $\pm$ 0.43	80.4 $\pm$ 1.96	99.9 $\pm$ 5.70

Table 11. Effect of intraperitoneal administration of xylazine in quails: temperature and respiration rate (Mean ± S.E.), n = 10

Intervals	Temperature (°C)	Respiration rate (min)
0 min	42.7 ± 0.14	47.4 ± 1.52
15 min	40.5 ± 0.25**	18.4 ± 1.79**
30 min	39.55± 0.33**	18.4 ± 0.79**
45 min	38.00± 0.47**	18.6 ± 1.97**
60 min	37.7 ± 0.47**	21.7 ± 1.94**
75 min	37.05± 0.42**	25.0 ± 1.45**
90 min	36.75± 0.39**	27.6 ± 1.51**
105 min	36.6 ± 0.29**	30.1 ± 1.26**
120 min	36.35± 0.31**	33.8 ± 0.99**
135 min	36.25± 0.28**	36.8 ± 0.64**
150 min	36.45± 0.39**	40.0 ± 0.74**
Third hour	36.8 ± 0.36**	41.5 ± 0.47**
24th hour	43.3 ± 0.14	46.4 ± 0.83
Fifth day	43.3 ± 0.20	45.0 ± 0.70

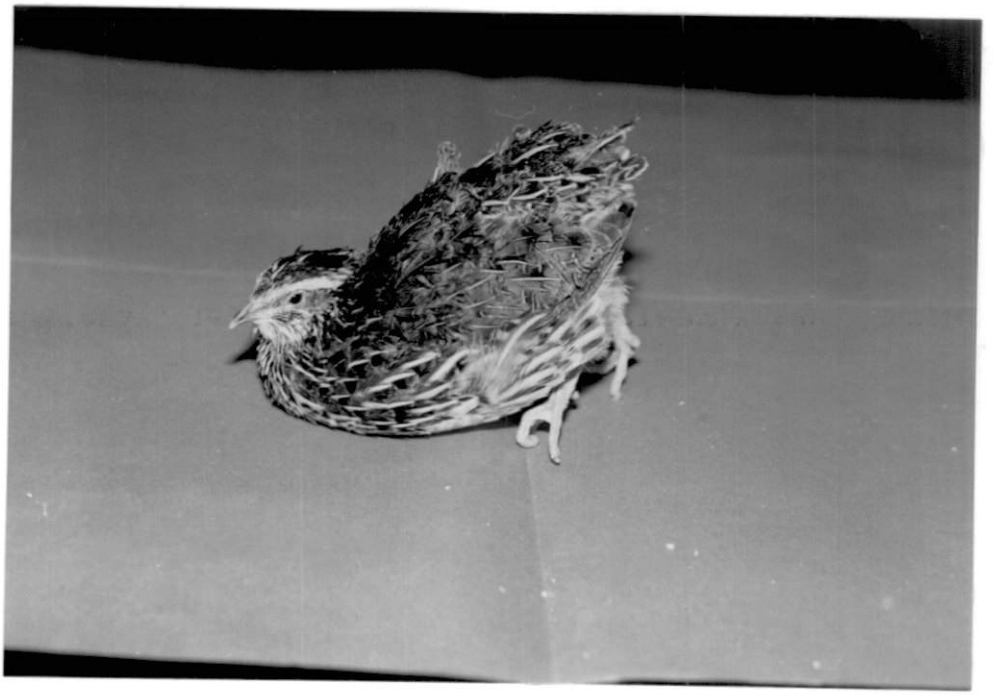
** Significant at 1 per cent level

Table 12. Effect of intraperitoneal administration of xylazine in quails: Haemogram (Mean ± S.E.), n=10

Parameters and units	Interval			
	0 min.	10 min.	24th hour	fifth day
Total erythrocyte count 10^6/ul)	3.84 ± 0.04	3.40 ± 0.03**	3.63 ± 0.04**	3.80 ± 0.04
Total leukocyte count 10^3/ul	22.43 ± 0.56	20.93 ± 0.46	21.44 ± 0.42	22.41 ± 0.46
Lymphocyte (%)	75.70 ± 0.47	71.20 ± 0.44**	72.60 ± 0.40**	74,50 ± 0.62
Heterophil (%)	22.50 ± 0.49	26.70 ± 0.56**	21.50 ± 0.40	22.00 ± 0.58
Eosinophil (%)	0.70 ± 0.14	0.80 ± 0.18	4.90 ± 0.22**	2.60 ± 0.32**
Monocyte (%)	0.60 ± 0.28	0.60 ± 0.28	0.60 ± 0.15	0.90 ± 0.26
Basophil (%)	0.50 ± 0.15	0.30 ± 0.14	0.30 ± 0.20	0.40 ± 0.15
Haemoglobin dl%	14.82 ± 0.19	12.82 ± 0.25**	14.14 ± 0.28	14.76 ± 0.16

** Significant at 1 per cent level

Fig.13 Anaesthesia: hock and vent raised (xylazine)



Sub-group B

Ketamine hydrochloride was administered at the rate of 150 mg per kg bodyweight intraperitoneally to all the quails in the sub-group.

The bodyweight of the quails belonging to this sub-group was 144.70 ± 6.66 g.

The observations are presented in Tables 13 to 15.

A. Clinical signs of anaesthesia

1. Onset of anaesthesia

The characteristic symptoms at the onset of anaesthesia were loss of balance, ruffled feathers, sitting posture, torticollis, loss of righting reflex, recumbency and gradual abolition of pedal reflex.

2. Time for induction

The time for induction was 5.50 ± 0.15 min. The induction was smooth and uneventful.

3. Duration of anaesthesia

The duration of anaesthesia was 99.90 ± 2.86 min. Clinical signs observed during the onset of anaesthesia became more pronounced during anaesthesia. Eyes were closed.

Palpebral reflex, corneal reflex and third eyelid movement persisted. Pedal reflex was abolished.

4. Duration of recovery

The duration of recovery was 97.50 ± 4.66 min. During recovery, paddling of limbs, torticollis and fluttering of wings were seen.

5. Temperature

The temperature (°C) before administration was 43.50 ± 0.25 and after administration it was 42.35 ± 0.28 at 15 min., 42.10 ± 0.38 at 30 min., 41.90 ± 0.35 at 45 min., 41.80 ± 0.34 at 60 min., 41.70 ± 0.34 at 75 min., 41.70 ± 0.31 at 90 min., 41.90 ± 0.33 at 105 min., 42.00 ± 0.28 at 120 min., 42.30 ± 0.20 at 135 min., 42.30 ± 0.20 at 150 min., 42.30 ± 0.20 at the third hour, 43.50 ± 0.15 at the 24th hours and 43.30 ± 0.20 on the fifth day.

There was significant ($P < 0.01$) reduction in the temperature upto the third hour which became near normal by 24 hours.

6. Respiration rate

The respiration rate (per minute) before administration was 55.20 ± 2.00 and after administration it

was 51.60 ± 1.38 at 15 min., 50.50 ± 2.12 at 30 min., 49.80 ± 1.39 at 45 min., 49.70 ± 1.67 at 60 min., 51.00 ± 2.02 at 75 min., 53.60 ± 2.44 at 90 min., 55.20 ± 2.37 at 105 min., 58.00 ± 2.13 at 120 min., 59.80 ± 1.82 at 135 min., 61.40 ± 1.79 at 150 min., 63.20 ± 1.39 at the third hour 58.80 ± 1.17 at the 24th hour and 57.10 ± 0.83 on the fifth day.

There was no significant reduction in the respiration rate upto 135 min but a significant ($P<0.05$) increase was seen at 150 min and at the third hour and reached near normal by 24 hours.

B. Haemogram

1. Total erythrocyte count

The total erythrocyte count ($10^6/\mu l$) before administration was 3.89 ± 0.04 and after administration it was 3.53 ± 0.05 at 10 min., 3.70 ± 0.04 at the 24th hour and 3.86 ± 0.04 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and at 24 hours which became near normal by the fifth day.

2. Total leukocyte count

The total leukocyte count ($10^3/\mu l$) before administration was 22.79 ± 0.28 and after administration it

was 21.26 ± 0.18 at 10 min., 22.11 ± 0.30 at the 24th hour and 22.81 ± 0.29 on the fifth day.

There was significant ($P < 0.01$) reduction at 10 min., which became near normal by 24 hours.

3. Differential count

Lymphocyte count

The lymphocyte count (per cent) before administration was 75.90 ± 0.51 and after administration it was 71.30 ± 0.61 at 10 min., 72.50 ± 0.57 at the 24th hour and 74.20 ± 0.57 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and on the fifth day.

Heterophil count

The heterophil count (per cent) before administration was 23.60 ± 0.37 and after administration it was 26.40 ± 0.63 at 10 min., 23.60 ± 0.83 at the 24th hour and 23.50 ± 0.53 on the fifth day.

There was significant ($P<0.01$) increase at 10 min., which became near normal by 24 hours.

Eosinophil count

The eosinophil count (per cent) before administration was 0.50 ± 0.21 and after administration it was 1.60 ± 0.35 at 10 min., 3.90 ± 0.60 at the 24th hour and 2.20 ± 0.18 on the fifth day.

There was significant ($P<0.01$) increase at 10 min., 24 hours and on the fifth day.

Monocyte count

The monocyte count (per cent) before administration was 0.20 ± 0.12 and after administration it was 0.60 ± 0.15 at 10 min., 0.50 ± 0.21 at the 24th hour and 0.30 ± 0.14 on the fifth day.

The variation in the count was not significant.

Basophil count

The basophil count (per cent) before administration was 0.00 ± 0.00 and after administration it was 0.20 ± 0.12 at 10 min., 0.00 ± 0.00 at the 24th hour and 0.10 ± 0.09 on the fifth day.

The variation in the count was not significant.

4. Haemoglobin content

The haemoglobin content (dl%) before administration was 14.78 $\pm$ 0.24 and after administration it was 12.84 $\pm$ 0.30 at 10 min., 13.92 $\pm$ 0.24 at 24 hours and 14.74 $\pm$ 0.18 on the fifth day.

There was significant ($P<0.01$) reduction at 10 min. and at 24 hours which became near normal by the fifth day.

C. Assessment of anaesthetic effect

Anaesthesia was satisfactory since no response could be evinced on incising and suturing the skin and the wall of the crop.

D. Side effects

On examination of the peritoneal cavity no gross lesions could be observed at the site of intraperitoneal injection. Liver showed mild fatty changes. Focal areas of congestion were present on the surface of the kidneys.

Table 13. Effects of intraperitoneal administration of ketamine hydrochloride in quails: time for induction, duration of anaesthesia and recovery

Bird No.	Bodyweight (g)	Quantity of drug administered (mg)	Time for induction (min)	Duration of anaesthesia (min)	Duration of recovery (min)
B_1	120	18	5	95	99
B_2	130	19.5	5	96	87
B_3	130	19.5	6	104	111
B_4	180	27	5	112	116
B_5	160	24	6	88	82
B_6	154	23.1	6	91	122
B_7	129	19.35	6	113	93
B_8	130	19.5	5	108	73
B_9	134	20.1	5	88	102
B_{10}	180	27	6	104	90
Mean $\pm$ S.E.	144.7 $\pm$ 6.66	21.70 $\pm$ 0.99	5.5 $\pm$ 0.15	99.9 $\pm$ 2.86	97.5 $\pm$ 4.66

Table 14. Effect of intraperitoneal administration of ketamine hydrochloride in quails : temperature and respiration rate (Mean ± S.E.), n =10

Intervals	Temperature (°C)	Respiration rate (min)
0 min	43.5 ± 0.25	55.2 ± 2.00
15 min	42.35± 0.28**	51.6 ± 1.38
30 min	42.1 ± 0.38**	50.5 ± 2.12
45 min	41.9 ± 0.35**	49.8 ± 1.39
60 min	41.8 ± 0.34**	49.7 ± 1.67
75 min	41.7 ± 0.34**	51.0 ± 2.02
90 min	41.7 ± 0.31**	53.6 ± 2.44
105 min	41.9 ± 0.33**	55.2 ± 2.37
120 min	42.0 ± 0.28**	58.0 ± 2.13
135 min	42.3 ± 0.20**	59.8 ± 1.82
150 min	42.3 ± 0.20**	61.4 ± 1.79*
Third hour	42.3 ± 0.20**	63.2 ± 1.39**
24th hour	43.5 ± 0.15	58.8 ± 1.17
Fifth day	43.3 ± 0.20	57.1 ± 0.83

** Significant at 1 per cent level

* Significant at 5 per cent level

Table 15. Effect of intraperitoneal administration of ketamine hydrochloride in pigeons: Haemogram (Mean ± S.E.), n=10

Parameters and units	Interval			
	0 min.	10 min.	24th hour	fifth day
Total erythrocyte count 10^6/ul)	3.63 ± 0.08	3.35 ± 0.09**	3.34 ± 0.09**	3.49 ± 0.08
Total leukocyte count 10^3/ul	12.95 ± 0.14	12.35 ± 0.14**	12.61 ± 0.15	12.68 ± 0.09
Lymphocyte (%)	68.20 ± 0.30	66.90 ± 0.43**	65.10 ± 0.76**	67.30 ± 0.73
Heterophil (%)	28.10 ± 0.33	27.30 ± 0.61	25.20 ± 0.68**	26.60 ± 0.79
Eosinophil (%)	2.30 ± 0.31	3.70 ± 0.73	4.50 ± 0.72*	3.80 ± 0.73
Monocyte (%)	1.10 ± 0.26	0.90 ± 0.22	2.00 ± 0.34	0.70 ± 0.31
Basophil (%)	0.30 ± 0.14	0.00 ± 0.00	0.20 ± 0.18	0.30 ± 0.14
Haemoglobin dl%	15.39 ± 0.25	13.84 ± 0.31**	14.52 ± 0.24**	15.12 ± 0.29

** Significant at 1 per cent level

* Significant at 5 per cent level

Sub-group C

Xylazine at the rate of 5 mg per kg bodyweight followed by ketamine hydrochloride at the rate of 75 mg per kg bodyweight were administered intraperitoneally to all the quails in the sub-group.

The bodyweight of the quails belonging to this sub-group was 137.10 ± 2.46 g.

The observations are presented in Tables 16 to 18.

A. Clinical signs of anaesthesia

1. Onset of anaesthesia

The characteristic symptoms at the onset of anaesthesia were loss of balance, ruffled feathers, dropping of wings, sitting posture, torticollis, loss of righting reflex, recumbency and gradual abolition of pedal reflex.

2. Time for induction

The time for induction was 8.30 ± 0.31 min. The induction was smooth and uneventful.

3. Duration of anaesthesia

The duration of anaesthesia was 202.50 ± 7.62 min. Clinical signs observed during the onset of anaesthesia became

more pronounced during anaesthesia. Eyes were closed. Palpebral reflex, corneal reflex and third eyelid movement persisted. Pedal reflex was abolished.

4. Duration of recovery

The duration of recovery was 73.80 ± 3.19 min. The recovery was smooth and uneventful.

5. Temperature

The temperature (°C) before administration was 42.20 ± 0.12 and after administration it was 39.50 ± 0.35 at 15 min., 38.20 ± 0.27 at 30 min., 37.20 ± 0.39 at 45 min., 36.70 ± 0.34 at 60 min., 36.00 ± 0.44 at 75 min., 35.55 ± 0.31 at 90 min., 35.40 ± 0.32 at 105 min., 34.80 ± 0.23 at 120 min., 34.70 ± 0.20 at 135 min., 34.90 ± 0.22 at 150 min., 35.00 ± 0.24 at the third hour, 42.30 ± 0.14 at the 24th hour and 42.70 ± 0.14 on the fifth day.

There was significant ($P < 0.01$) reduction in the temperature upto the third hour which became near normal by 24 hours.

6. Respiration rate

The respiration rate (per minute) before administration was 52.20 ± 0.69 and after administration it

was 30.50 ± 1.32 at 15 min., 25.00 ± 1.30 at 30 min., 22.00 ± 0.98 at 45 min., 19.00 ± 0.70 at 60 min., 18.20 ± 0.52 at 75 min., 19.20 ± 0.64 at 90 min., 20.80 ± 0.75 at 105 min., 23.50 ± 0.79 at 120 min., 26.20 ± 0.87 at 135 min., 29.40 ± 1.06 at 150 min., 37.00 ± 1.88 at the third hour 52.40 ± 0.79 at the 24th hour and 52.80 ± 1.06 on the fifth day.

There was significant ($P<0.01$) reduction in respiration rate upto the third hour which became near normal by 24 hours.

B. Haemogram

1. Total erythrocyte count

The total erythrocyte count ($10^6/\mu l$) before administration was 3.93 ± 0.05 and after administration it was 3.57 ± 0.07 at 10 min., 3.70 ± 0.05 at the 24th hour and 3.88 ± 0.04 on the 5th day.

There was significant ($P<0.01$) decrease at 10 min. and at 24 hours which became near normal by the fifth day.

2. Total leukocyte count

The total leukocyte count ($10^3/\mu l$) before administration was 22.57 ± 0.39 and after administration it

was 20.79 ± 0.27 at 10 min., 21.73 ± 0.33 at the 24th hour and 22.21 ± 0.36 on the fifth day.

There was significant (P <0.01) reduction at 10 min., which became near normal by 24 hours.

3. Differential count

Lymphocyte count

The lymphocyte count (per cent) before administration was 76.4 ± 0.37 and after administration it was 71.9 ± 0.33 at 10 min., 72.40 ± 0.42 at the 24th hour and 74.10 ± 0.59 on the fifth day.

There was significant (P<0.01) reduction at 10 min., 24 hours and on the fifth day.

Heterophil count

The heterophil count (per cent) before administration was 23.0 ± 0.60 and after administration it was 26.60 ± 0.56 at 10 min., 22.60 ± 0.72 at the 24th hour and 22.70 ± 0.56 on the fifth day.

After an initial increase in the count which was significant (P <0.01) at 10 min., the count became near normal by 24 hours.

Eosinophil count

The eosinophil count (per cent) before administration was 0.50 ± 0.15 and after administration it was 0.90 ± 0.22 at 10 min., 4.20 ± 0.39 at the 24th hour and 2.70 ± 0.28 on the 5th day.

There was significant ($P<0.01$) increase at the 24th hour and on fifth day.

Monocyte count

The monocyte count (per cent) before administration was 0.20 ± 0.12 and after administration it was 0.40 ± 0.15 at 10 min., 0.70 ± 0.20 at the 24th hour and 0.30 ± 0.14 on the fifth day.

The variation in the count was not significant.

Basophil count

The basophil count (per cent) before administration was 0.20 ± 0.12 and after administration it was 0.40 ± 0.15 at 10 min., 0.30 ± 0.20 at the 24th hour and 0.30 ± 0.14 on the fifth day.

The variation in the count was not significant.

4. Haemoglobin content

The haemoglobin content (dl%) before administration was 14.60 ± 0.22 and after administration it was 12.60 ± 0.23 at 10 min., 13.56 ± 0.16 at 24 hours and 14.48 ± 0.20 on the fifth day.

There was significant ($P<0.01$) decrease at 10 min. and 24 hours which became near normal by the fifth day.

C. Assessment of anaesthetic effect

Anaesthesia was satisfactory since no response could be evinced on incising and suturing the skin and the wall of the crop.

D. Side effects

On examination of the peritoneal cavity no gross lesions could be observed at the site of intraperitoneal injection. Liver showed mild fatty changes. Areas of mild congestion on the surface of the kidneys were observed.

Table 16. Effects of intraperitoneal administration of xylazine followed by ketamine hydrochloride in quails: time for induction, duration of anaesthesia and recovery

Bird No.	Bodyweight (g)	Quantity of drug administered (mg)		Time for induction (min)	Duration of anaesthesia (min)	Duration of recovery (min)
		Xylazine	Ketamine			
C_1	132	0.66	9.9	7	182	64
C_2	127	0.63	9.52	7	270	73
C_3	132	0.66	9.9	8	202	85
C_4	147	0.73	11.02	8	180	81
C_5	137	0.68	10.2	10	194	70
C_6	152	0.76	11.4	10	191	67
C_7	128	0.64	7.6	9	202	60
C_8	135	0.67	10.12	8	195	63
C_9	137	10.2	8	199	86	
C_{10}	144	0.72	10.8	8	210	89
Mean $\pm$ S.E.	137.1$\pm$2.46	6.83$\pm$0.01	10.26$\pm$0.18	8.3$\pm$0.31	202.5$\pm$7.62	73.8$\pm$3.19

Table 17. Effect of intraperitoneal administration of xylazine followed by ketamine hydrochloride in quails: temperature and respiration rate (Mean ± S.E.), n = 10

Intervals	Temperature (°C)	Respiration rate (min)
0 min	42.2 ± 0.12	52.0 ± 0.69
15 min	39.5 ± 0.35**	30.5 ± 1.32**
30 min	38.2 ± 0.27**	25.0 ± 1.30**
45 min	37.2 ± 0.39**	22.0 ± 0.98**
60 min	36.7 ± 0.34**	19.0 ± 0.70**
75 min	36.00± 0.44**	18.2 ± 0.52**
90 min	35.55± 0.31**	19.2 ± 0.64**
105 min	35.4 ± 0.32**	20.8 ± 0.75**
120 min	34.8 ± 0.23**	23.5 ± 0.79**
135 min	34.7 ± 0.20**	26.2 ± 0.87**
150 min	34.9 ± 0.22**	29.4 ± 1.06**
Third hour	35.0 ± 0.24**	37.0 ± 1.88**
24th hour	42.3 ± 0.14	52.4 ± 0.79
Fifth day	42.7 ± 0.14	52.8 ± 1.06

** Significant at 1 per cent level

Table 18. Effect of intraperitoneal administration of xylazine followed by ketamine hydrochloride in quails: Haemogram (Mean ± S.E.), n=10

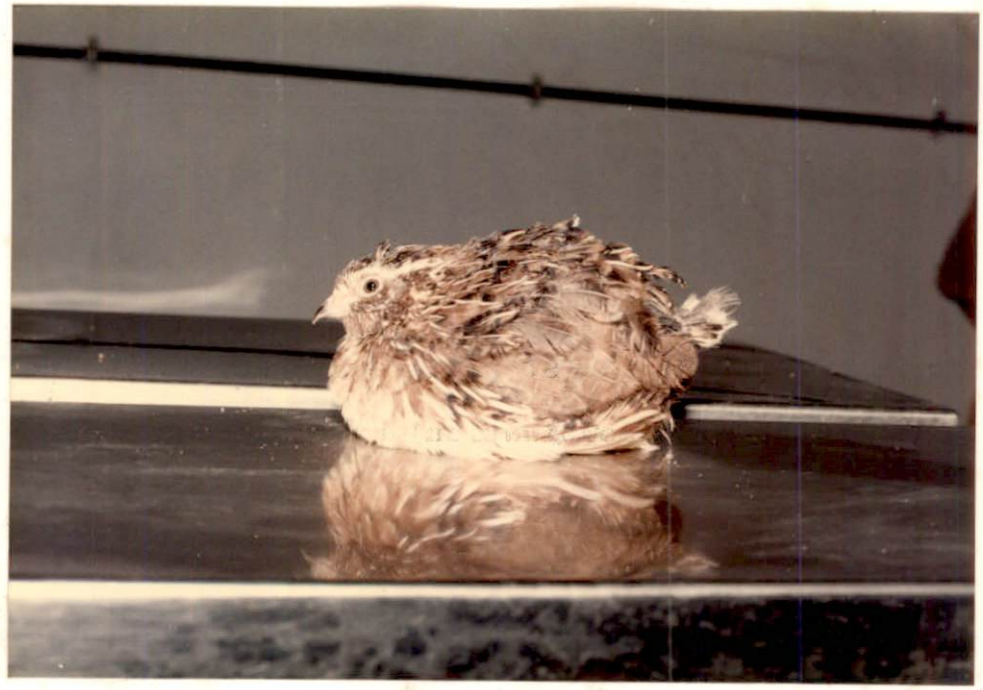
Parameters and units	Interval			
	0 min.	10 min.	24th hour	fifth day
Total erythrocyte count 10^6/ul)	3.93 ± 0.05	3.57 ± 0.07**	3.70 ± 0.05**	3.88 ± 0.04
Total leukocyte count 10^3/ul	22.57 ± 0.39	20.79 ± 0.27**	21.73 ± 0.33	22.21 ± 0.36
Lymphocyte (%)	76.40 ± 0.37	71.90 ± 0.33**	72.40 ± 0.42**	74.10 ± 0.59**
Heterophil (%)	23.00 ± 0.60	26.60 ± 0.56**	22.60 ± 0.72	22.70 ± 0.56
Eosinophil (%)	0.50 ± 0.15	0.90 ± 0.22	4.20 ± 0.39**	2.70 ± 0.28**
Monocyte (%)	0.20 ± 0.12	0.40 ± 0.15	0.70 ± 0.20	0.30 ± 0.14
Basophil (%)	0.20 ± 0.12	0.40 ± 0.15	0.30 ± 0.20	0.30 ± 0.14
Haemoglobin dl%	14.60 ± 0.22	12.60 ± 0.23**	13.56 ± 0.16**	14.48 ± 0.20

** Significant at 1 per cent level

Fig.14 Anaesthesia: sitting posture (xylazine-ketamine combination)

Fig.15 Anaesthesia: Sternal recumbency (xylazine-ketamine-combination)

Fig.16 Anaesthesia: Lateral recumbency (xylazine-ketamine combination)



Discussion

DISCUSSION

Group I Pigeons

The mean bodyweight of pigeons in sub-group A was 141 ± 2.21 g.

Xylazine was administered at the rate of 10 mg per kg bodyweight intraperitoneally. Satisfactory anaesthesia was achieved with this dose level. Satisfactory anaesthesia with the administration of the same dose of xylazine intramuscularly was reported by Levinger et al. (1973) in pigeons, quails, chickens, turkeys, budgerigars, stone curlew, night heron, purple heron and cattle egrets.

The mean bodyweight of pigeons in sub-group B was 176 ± 13.51 g.

Ketamine hydrochloride was administered at the rate of 150 mg per kg bodyweight intraperitoneally. Satisfactory anaesthesia was achieved with this dose level. Satisfactory anaesthesia was reported by Kittle (1971) with the intramuscular administration of ketamine at the rate of 100 mg per lb bodyweight in pigeons, 200 mg per lb bodyweight in black vulture and, 80 mg per lb bodyweight in red-tailed hawk. In pigeons, a dose of 75 to 150 mg

per kg bodyweight administered intramuscularly was reported to produce light anaesthesia (Neal et al., 1981). However, Boever and Wright (1975) administered ketamine at the rate of 0.04 to 0.17 mg per g bodyweight intramuscularly to pigeons which resulted in immobilization.

In other birds, the dose of ketamine was 0.05 to 0.10 mg per g bodyweight intramuscularly in parakeets (Mandelker, 1973), 51.72 mg per kg bodyweight intramuscularly in feral pigeons (Samour et al., 1984), 30 mg per kg bodyweight intramuscularly in diurnal birds of prey and owls (Heidenreich, 1978), intraperitoneal administration of ketamine at the dose of 100 mg per kg bodyweight in chicken and ducks (Devanand, 1991).

Borzoi (1973) suggested that ketamine at a dose rate of 15 to 20 mg per kg bodyweight intramuscularly was adequate for immobilization in 22 birds.

The mean bodyweight of pigeons in sub-group C was 140 $\pm$ 4.69 g.

Xylazine was administered at the rate of 5 mg per kg bodyweight followed by ketamine hydrochloride at the rate of 75 mg per kg bodyweight intraperitoneally. Satisfactory anaesthesia was achieved at this dose level. A dose of 2.0 mg per kg bodyweight of ketamine combined with 2.0 mg per kg

bodyweight of xylazine intramuscularly was found satisfactory in three-week-old Leghorns (Harvey et al., 1985), a combination of 4.83 mg per kg bodyweight of ketamine and 0.38 mg per kg bodyweight of xylazine intramuscularly produced excellent sedation in griffon vultures (Petruzzi et al., 1988) and a combination of 18.43 mg per kg bodyweight of ketamine and 1.52 mg per kg bodyweight of xylazine in small raptors.

Loss of balance, ruffled feathers, sitting posture, recumbency and gradual abolition/sluggishness of pedal reflex were observed in all the three sub-groups during the onset of anaesthesia. Similar observations were made in pigeons, quails, turkeys, chicken, cattle egrets, budgerigars, night heron, purple heron and stone curlew (Levinger et al., 1973) in 154 species of birds (Samour et al.,1984) and in chicken and ducks (Devanand, 1991).

When xylazine alone was administered, droopiness and sluggishness of pedal reflex were also observed during the onset of anaesthesia. This is in agreement with the observations of Levinger et al. (1973) in pigeons, quails, chicken, turkeys, cattle egrets, budgerigars, night heron, purple heron, and stone curlew and Devanand (1991) in chicken and ducks.

When ketamine alone was administered, fluttering and

dropping of wings, dropping of beak, torticollis and loss of righting reflex were also noticed. This is in agreement with the observations of McGrath et al. (1984) in chicken, Samour et al. (1984) in 135 species birds, Christensen et al. (1987) in domestic fowl and Devanand (1991) in chicken and ducks.

When xylazine - ketamine combination was administered dropping of wings, dropping of beak, loss of righting reflex and torticollis were also seen. Similar observations were recorded by McGrath et al. (1984) in chicken, Christensen et al. (1987) in domestic fowl and Devanand (1991) in chicken and ducks.

During anaesthesia, pedal reflex was sluggish or abolished in all the sub-groups. Abolition of pedal reflex was observed during anaesthesia in red-tailed hawk (Kittle, 1971), in ostriches (Gandini et al., 1986), in domestic fowl (Christensen et al., 1987) and in chicken and ducks (Devanand, 1991).

Palpebral and corneal reflexes and third eyelid movement persisted in all the pigeons. Palpebral reflex was reported to be persistent in pigeons and red-tailed hawk (Kittle, 1971), in 154 species of birds (Samour et al., 1984), in ostriches (Gandini et al., 1986), in domestic fowl (Christensen et al., 1987) and in chicken and ducks

(Devanand, 1991). In the present study, the eyes remained closed during anaesthesia. Similar findings were reported during thiopentone sodium anaesthesia in sparrows, canaries, chicken and parakeets (Donovan, 1958) and in chicken and ducks (Devanand, 1991). The eyes remained open during anaesthesia with xylazine, ketamine and a combination of the two in 154 species of birds (Samour et al., 1984).

The time for induction was 12.7 ± 0.40 min., 7.60 ± 0.42 min. and 6.80 ± 0.34 min. in sub-groups A, B and C respectively. The time for induction was minimum when xylazine followed by ketamine was administered and was maximum when xylazine alone was administered. The induction was smooth and uneventful in all the pigeons. Similar observations were reported in raptors (Redig and Duke, 1976), in 147 species of birds (Samour et al., 1984), in ostriches (Gandini et al., 1986, Cornick and Jensen, 1992), in domestic fowl (Christensen et al., 1987) in turkeys, (Gonder and Barnes, 1989), in chicken and ducks Devanand (1991) and in ostriches

The duration of anaesthesia was 47.70 ± 1.54 min., when xylazine alone was administered. Surgical anaesthesia was never achieved (Samour et al., 1984) in 11 species of birds with xylazine. The duration of anaesthesia was 37.80 ± 2.88 min., when ketamine alone was administered. A duration of

35.00 ± 5.0 min. was observed in 135 species of birds (Samour et al., 1984) which is in agreement with the findings of the present study. The duration of anaesthesia was 62.0 ± 1.15 min., when xylazine-ketamine combination was used. According to Samour et al. (1984) it was 45 ± 15 min. The longer duration observed in the present study could be because of the higher dose of the drugs used in this combination. The duration of anaesthesia was maximum when xylazine-ketamine combination was used and minimum when ketamine alone was used.

The duration of recovery was 164.8 ± 2.82 min., when xylazine alone was used. The recovery period was prolonged in 11 species of birds (Samour et al., 1984). The duration of recovery was 87.7 ± 2.98 min., when ketamine alone was administered. The recovery was characterized by fluttering of wings and torticollis. Similar findings were reported in chicken owls, hawks and other larger birds (Boever and Wright, 1975), in chicken (McGrath et al., 1984) and in 135 species of birds (Samour et al., 1984). The duration of recovery was 85.1 ± 2.72 min., when xylazine-ketamine combination was administered. Recovery was smooth and uneventful. Similar findings were reported in 11 species of birds (Samour et al., 1984).

There was significant fall in the temperature in all the sub-groups during anaesthesia which became near normal

within 24 hours (Fig.17). A fall in the temperature was reported in geese, ducks and chicken (Lee, 1953) in chicken, owls, hawks and other larger birds (Boever and Wright, 1975), in ostriches (Gandini et al., 1986), in domestic fowl (Christensen et al., 1987) in turkeys (Gonder and Barnes, 1989) and in chicken and ducks (Devanand, 1991).

There was significant reduction in the respiration rate during anaesthesia in sub-groups A and C which became near normal by 24 hours (Fig.18). Similar findings were reported in six species of birds (Samour et al., 1984), in Pekin ducks (Ludders et al., 1989), in caged birds (Doolen and Jackson, 1991), in ostriches (Matthews et al., 1991, Cornick and Jensen, 1992). When ketamine alone was administered, there was significant reduction in the respiration rate upto 105 min., then stabilized for 30 min., thereafter, there was significant increase upto the 3rd hour which became near normal by 24th hour (Fig.18). Devanand (1991) reported an initial rise followed by a gradual reduction in the respiration rate in chicken and ducks.

The total erythrocyte count decreased in all the sub-groups but, it was significant at 10 min. and 24 hours in sub-groups B and C which became near normal by 24 hours (Fig. 19). This is in agreement with the findings of Soliman et al. (1965), Nara et al. (1979) and Sharma et al. (1983a & b) in

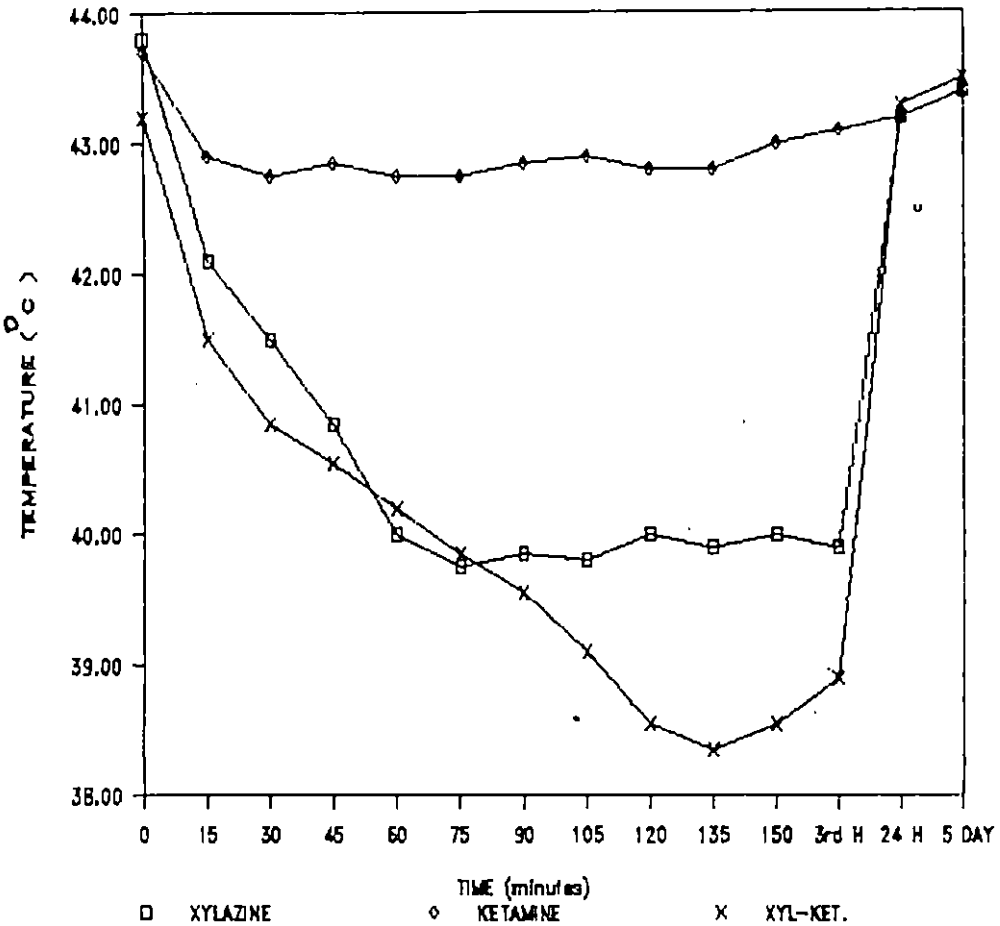
dogs, Kumar et al. (1974) in sheep, Kumar and Sharma (1986) in buffaloes, Pfeil and Duesterberg (1987) in cats and Devanand (1991) in chicken and ducks.

There was significant decrease in the total leukocyte count at 10 min. and at 24 hours in sub-groups A and C and at 10 min. in sub group B all of which became near normal by the fifth day. The total leukocyte count recorded an increase in sub-group A on the fifth day but the increase was not significant (Fig.20). Similar findings were reported by Soliman (1965), Sharma et al. (1984a & b) and Nara et al. (1979) in dogs, Kumar et al. (1974) in sheep, Kumar and Sharma (1986) in buffaloes, Pfeil and Duesterberg (1987) in cats and Devanand (1991) in chicken.

The lymphocyte count recorded significant decrease in all the sub-groups at 10 min. and 24 hours which became near normal by the fifth day (Fig.21). The heterophil count was on the increase at 10 min. in sub-groups A and C but was significant only in sub-group C. There was a decrease in the count at 10 min., 24 hours and on the fifth day in sub-group B but was significant only at 24 hours. In sub-groups A and C there was a decrease in the count at 24 hours and on the fifth day though not significant (Fig.22). There was a significant increase in the eosinophil count at 10 min., 24 hours and on

Fig.17 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on temperature in pigeons

Fig.18 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on respiration rate in pigeons


44.00
43.00
42.00
41.00
40.00
39.00
38.00
TEMPERATURE (°C)
0
15
30
45
60
75
90
105
120
135
150
3rd H
24 H
5 DAY
TIME (minutes)
XYLAZINE
KETAMINE
XYL-KET.

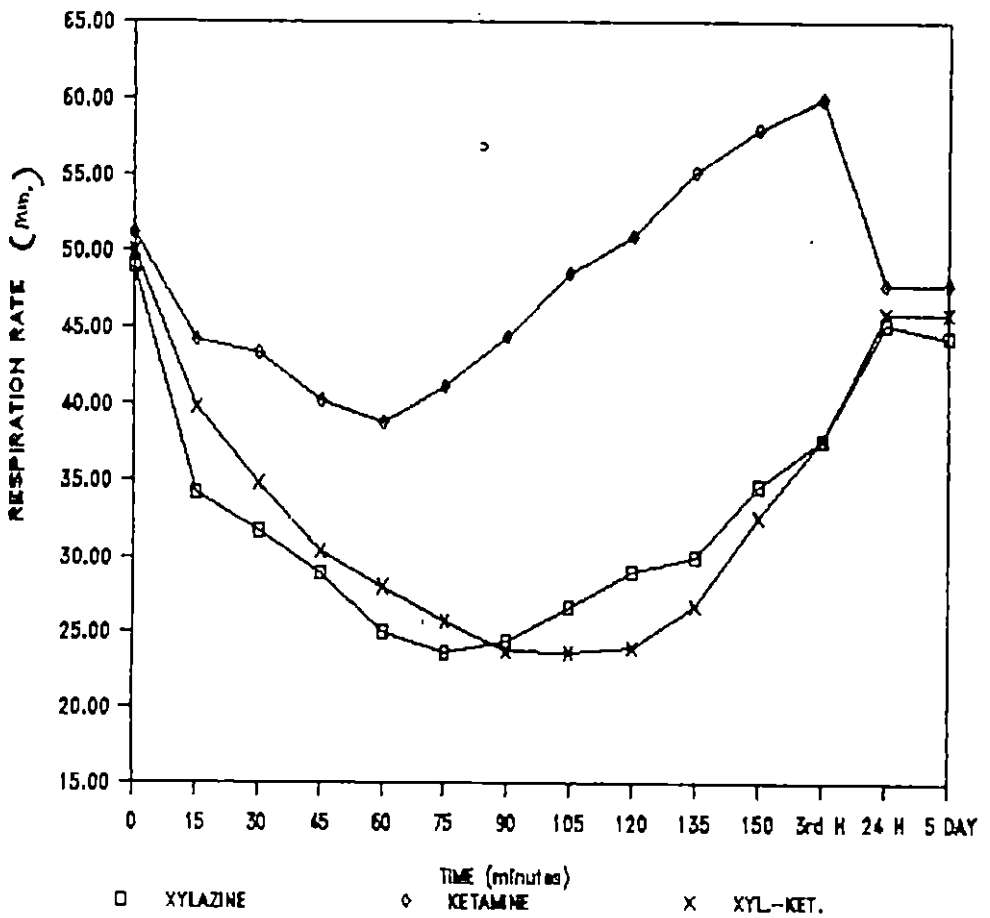
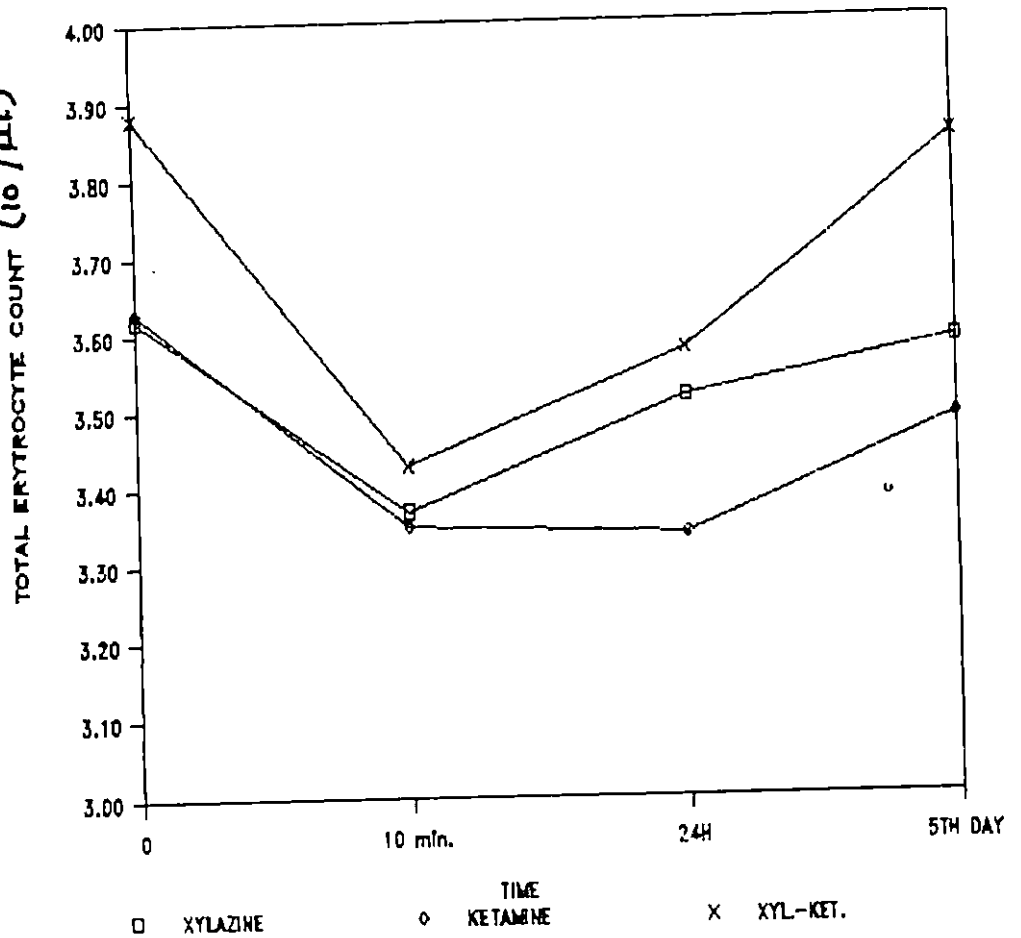

65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
RESPIRATION RATE (/min.)
0
15
30
45
60
75
90
105
120
135
150
3rd H
24 H
5 DAY
TIME (minutes)
XYLAZINE
KETAMINE
XYL-KET.

Fig.19 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on total erythrocyte count in pigeons

Fig.20 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on total leukocyte count in pigeons


TOTAL ERYTROCYTE COUNT ($10^6/\mu l$)
4.00
3.90
3.80
3.70
3.60
3.50
3.40
3.30
3.20
3.10
3.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.

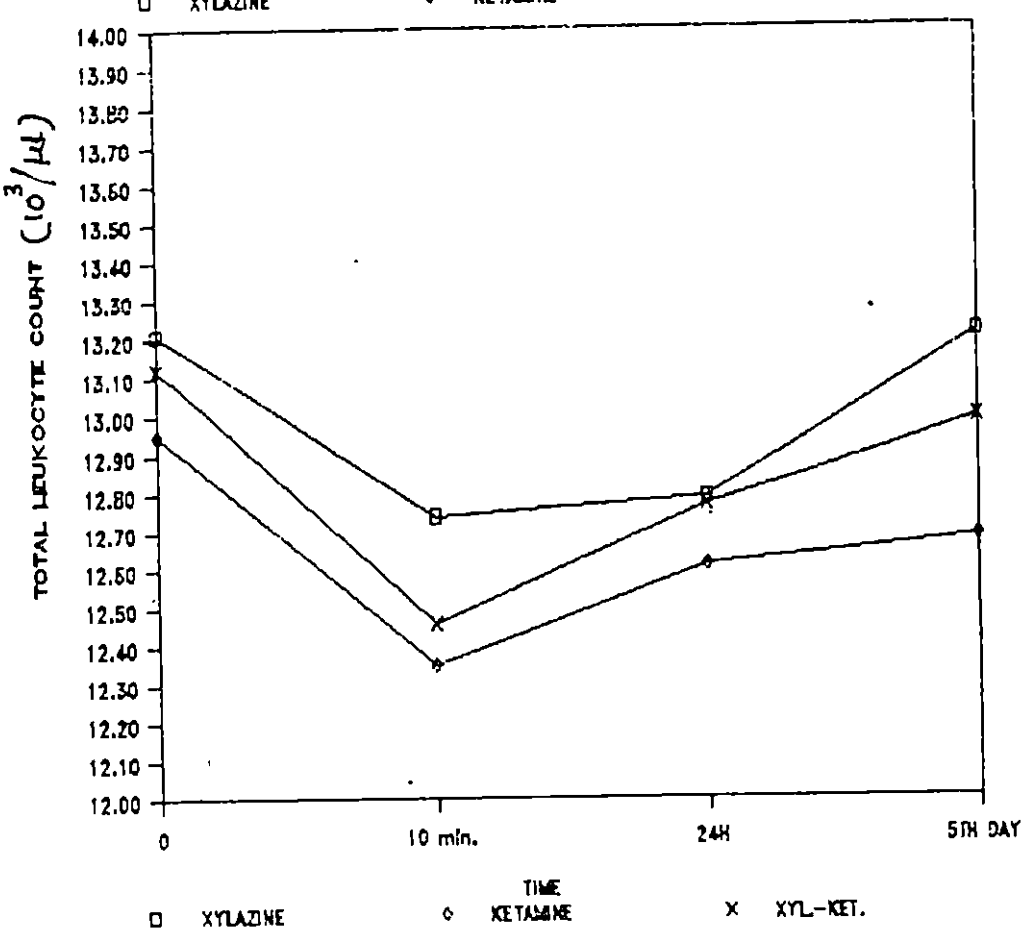
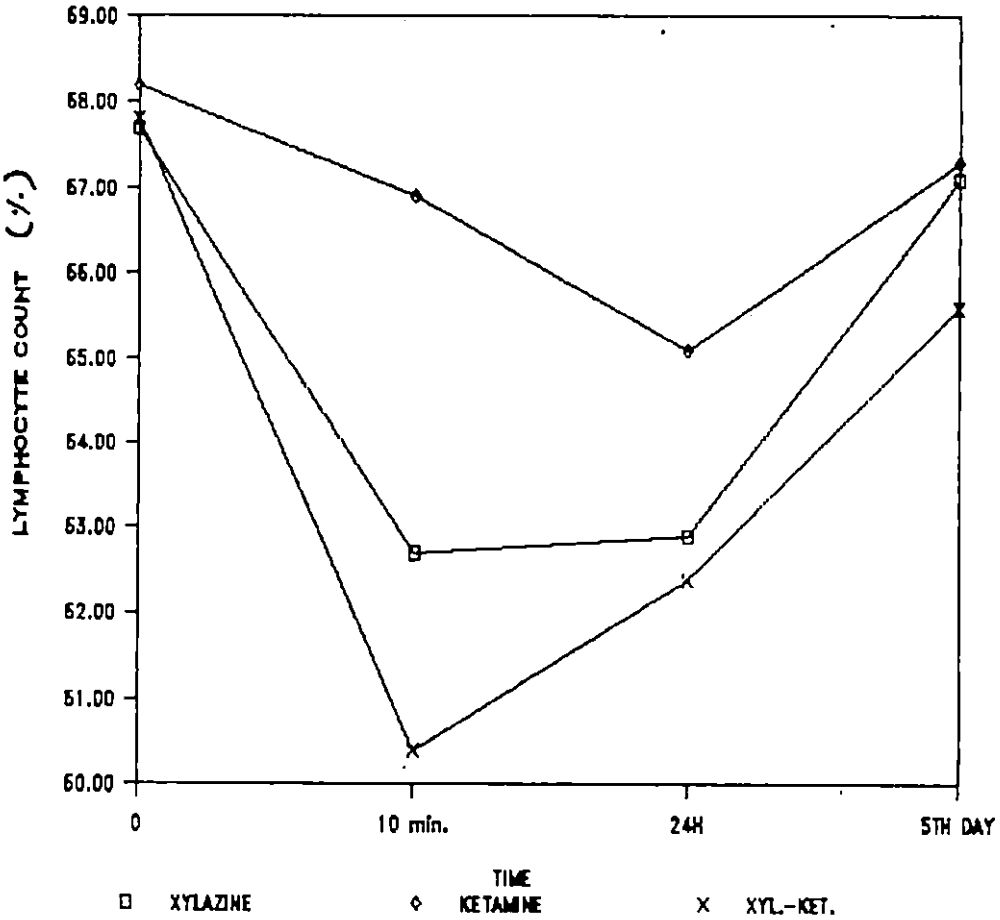
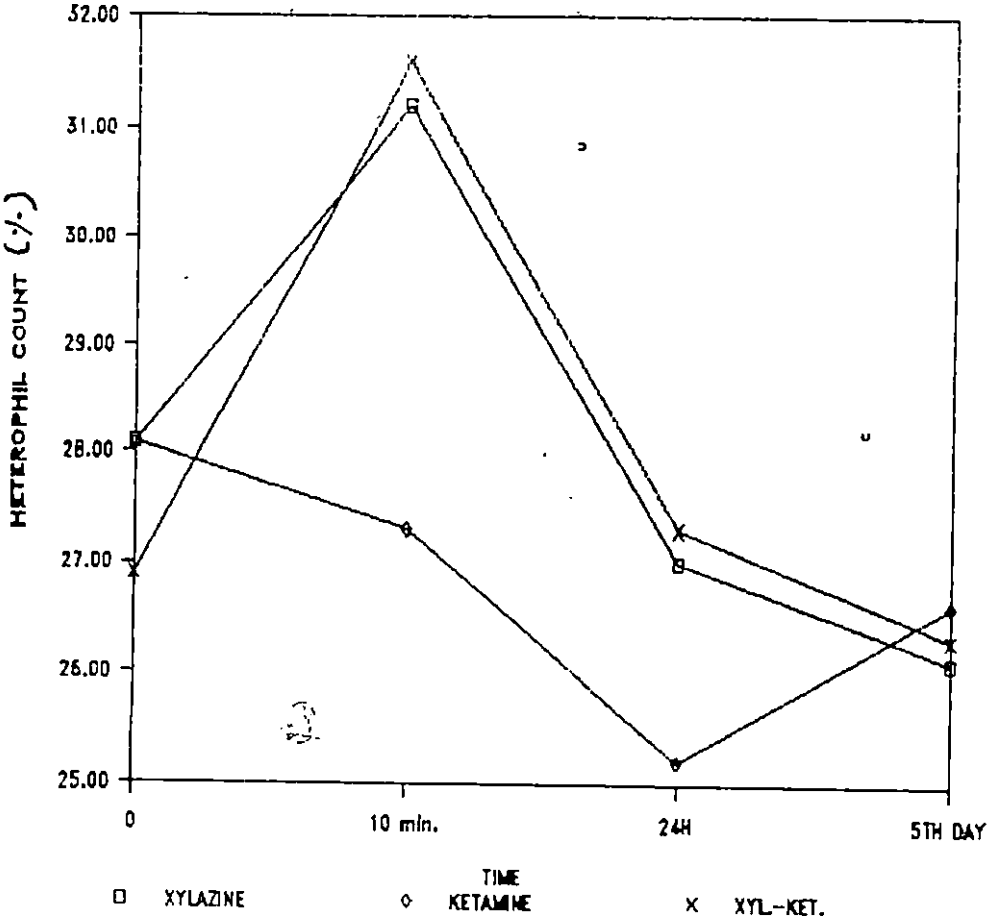

TOTAL LEUKOCYTE COUNT ($10^3/\mu l$)
14.00
13.90
13.80
13.70
13.60
13.50
13.40
13.30
13.20
13.10
13.00
12.90
12.80
12.70
12.60
12.50
12.40
12.30
12.20
12.10
12.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.

Fig.21 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on lymphocyte count in pigeons

Fig.22 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on heterophil count in pigeons


69.00
68.00
67.00
66.00
65.00
64.00
63.00
62.00
61.00
60.00
LYMPHOCYTE COUNT (%)
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.


32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
HETEROPHIL COUNT (%)
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.

the fifth day in sub-groups A and C and at 24 hours in sub-group C which became near normal by the fifth day (Fig. 23). According to Soliman et al. (1965) and Nara et al. (1979) in dogs and Devanand (1991) in chicken and ducks there was a decrease in the lymphocyte count and an increase in the heterophil count. An increase in the eosinophil count was reported in chicken and ducks (Devanand, 1991). While Soliman et al. (1965) reported a decrease in the eosinophil count in dogs.

There was no significant variation in the monocyte count in sub-groups A and B. There was significant reduction in the monocyte count at 10 min., 24 hours and on the fifth day in sub-group C. According to Pfeil and Duesterberg (1987) there was a reduction in the monocyte count in cats. Devanand (1991) reported that there was no variation in the count in chicken and ducks.

There was significant reduction in the basophil count at 10 min. and on the fifth day. According to Soliman et al. (1965) in dogs there was a decrease in the basophil count. Devanand (1991) reported that there was no variation in the count in chicken and ducks.

Reduction in the haemoglobin content was observed in all the sub-groups but it was significant at 10 min. and at 24

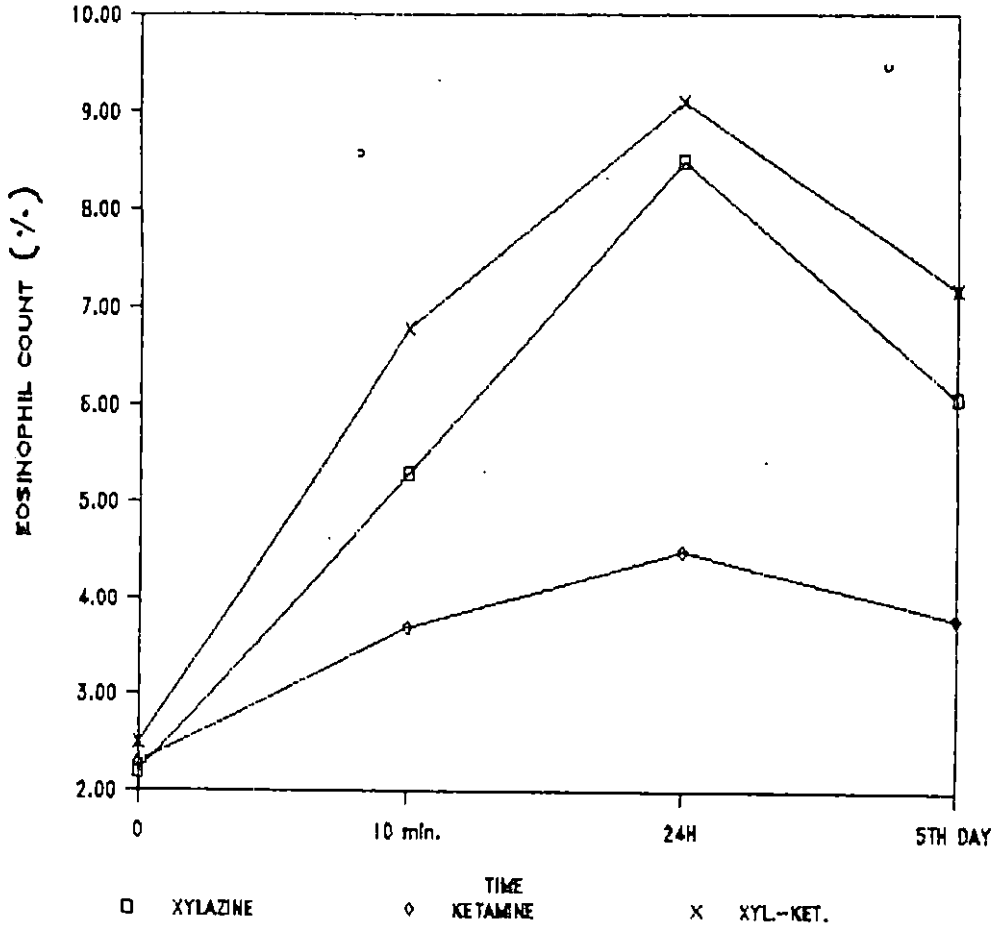
hours in sub-groups A and B and at 10 min. in sub-group C. which became near normal by the fifth day (Fig.24). Reduction in the haemoglobin content had been recorded by Soliman et al. (1965), Nara et al. (1979) and Sharma et al. (1983a & b) in dogs, Kumar et al. (1974) in sheep, Pfeil and Deusterberg (1987) in cats and Devanand (1991) in chicken and ducks.

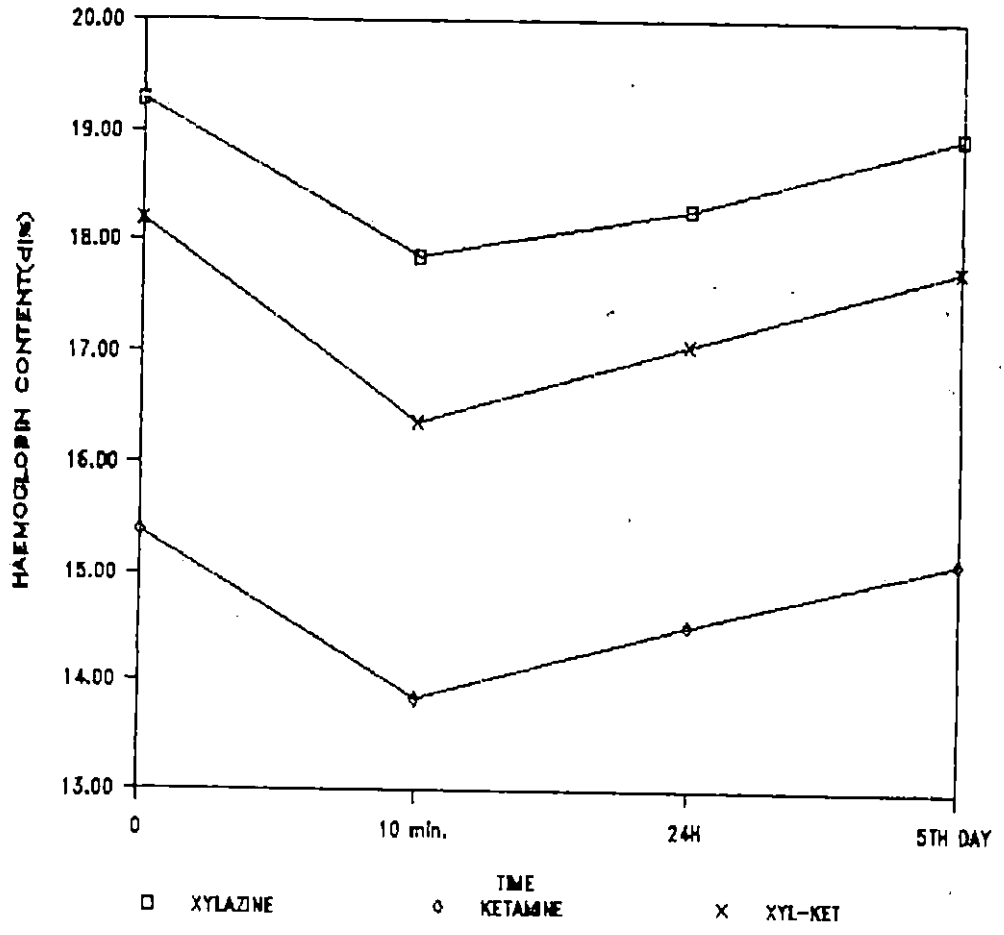
In all the sub-groups, no responses were noticed on incising and suturing the skin and the wall of the crop.

Mild fatty changes in the liver and congestion on the surface of the kidneys were observed in all the sub-groups. No tissue reaction was observed at the point of entry of the needle.

Fig.23 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on eosinophil count in pigeons

Fig.24 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on haemoglobin content in pigeons


EOSINOPHIL COUNT (%)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.


HAEMOGLOBIN CONTENT(gm%)
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL-KET

Group II Quails

The mean bodyweight of quails in sub-group A was 145 ± 3.30 g.

Xylazine was administered at the rate of 10 mg per kg bodyweight intraperitoneally. Light anaesthesia was achieved with this dose level. Satisfactory anaesthesia with the administration of the same dose of xylazine intramuscularly was reported by Levinger et al. (1973) in pigeons, quails, chicken, turkeys, budgerigars, stone curlew, night heron, purple heron and cattle egrets.

The mean bodyweight of quails in sub-group B was 144.7 ± 6.66 g.

Ketamine hydrochloride was administered at the rate of 150 mg per kg bodyweight intraperitoneally. Satisfactory anaesthesia was achieved with this dose level.. Satisfactory anaesthesia was reported by Kittle (1971) with the intramuscular administration of ketamine at the rate of 100 mg per lb bodyweight in pigeons, 200 mg per lb bodyweight in black vulture and, 80 mg per lb bodyweight in red-tailed hawk. In pigeons, a dose of 75 to 150 mg per kg bodyweight administered intramuscularly was reported to produce light anaesthesia (Neal et al., 1981). However, Boever and Wright (1975) administered ketamine at the

rate of 0.04 to 0.17 mg per g bodyweight intramuscularly to pigeons which resulted in immobilization.

The mean bodyweight of quails in sub-group C was 137.1 ± 2.46 g.

Xylazine was administered at the rate of 5 mg per kg bodyweight followed by ketamine hydrochloride at the rate of 75 mg per kg bodyweight intraperitoneally. Satisfactory anaesthesia was achieved at this dose level. A dose of 2.0 mg per kg bodyweight of ketamine combined with 2.0 mg per kg bodyweight of xylazine intramuscularly was found satisfactory in three-week-old Leghorns (Harvey et al., 1985), a combination of 4.83 mg per kg bodyweight of ketamine and 0.38 mg per kg bodyweight of xylazine intramuscularly produced excellent sedation in griffon vultures (Petruzzi et al., 1988) and a combination of 18.43 mg per kg bodyweight of ketamine and 1.52 mg per kg bodyweight of xylazine in small raptors.

Loss of balance, ruffled feathers, sitting posture, recumbency and gradual abolition/sluggishness of pedal reflex were observed in all the three sub-groups during the onset of anaesthesia. Similar observations were made in pigeons, quails, turkeys, chicken, cattle egrets, budgerigars, night heron, purple heron and stone curlew (Levinger et al., 1973) in 154 species of birds (Samour et al., 1984) and in chicken and ducks (Devanand, 1991).

When xylazine alone was administered, droopiness, dropping of wings and sluggishness of pedal reflex were also observed during the onset of anaesthesia. This is in agreement with the observations of Levinger et al. (1973) in pigeons, quails, chicken, turkeys, cattle egrets, budgerigars, night heron, purple heron, and stone curlew and Devanand (1991) in chicken and ducks.

When ketamine alone was administered, torticollis and loss of righting reflex were also noticed. This is in agreement with the observations of McGrath et al. (1984) in chicken, Samour et al. (1984) in 135 species of birds, Christensen et al. (1987) in domestic fowl and Devanand (1991) in chicken and ducks.

When xylazine-ketamine combination was administered, dropping of wings, loss of righting reflex and torticollis were also seen. Similar observations were recorded by McGrath et al. (1984) in chicken and Devanand (1991) in chicken and ducks.

During anaesthesia, pedal reflex was sluggish or abolished in all the sub-groups. Abolition of pedal reflex was observed during anaesthesia in red-tailed hawk (Kittle, 1971), in ostriches (Gandini et al., 1986), in domestic fowl

(Christensen et al., 1987) and in chicken and ducks (Devanand, 1991).

Palpebral and corneal reflexes and third eyelid movement persisted in all the quails. Palpebral reflex was reported to be persistent in pigeons and red-tailed hawk (Kittle, 1971), in 154 species of birds (Samour et al., 1984), in ostriches (Gandini et al., 1986), in domestic fowl (Christensen et al., 1987) and in chicken and ducks (Devanand, 1991). In the present study, the eyes remained closed during anaesthesia. Similar findings were reported during thiopentone sodium anaesthesia in sparrows, canaries, chicken and parakeets (Donovan, 1958) and in chicken and ducks (Devanand, 1991). The eyes remained open during anaesthesia with xylazine, ketamine and a combination of the two in 154 species of birds (Samour et al., 1984).

The time for induction was 13.1 $\pm$ 0.43 min., 5.5 $\pm$ 0.15 min. and 8.3 $\pm$ 0.31 min. in sub-groups A, B and C respectively. The time for induction was minimum when ketamine alone was administered and maximum when xylazine alone was administered. The induction was smooth and uneventful in all the quails. This is in agreement with the observations of Redig and Duke (1976) in raptors, Samour et al. (1984) in 147 species of birds, Gandini et al. (1986) and Cornick and Jensen (1992) in ostriches, Christensen et al.

(1987) in domestic fowl, Gonder and Barnes (1989) in turkeys, Devanand (1991) in chicken and ducks.

The duration of anaesthesia was 80.4 ± 1.96 min. when xylazine alone was administered. According to Samour et al. (1984) in 11 species of birds surgical anaesthesia was never achieved when xylazine alone was used. The duration of anaesthesia when ketamine alone was administered was 99.9 ± 2.86 min. According to Samour et al. (1984) it was 35.0 ± 5.0 min. at a dose of 51.72 mg per kg bodyweight. This dose is one third of the dose administered in the present study. The longer duration observed in the present study could be because of the higher dose administered. The duration of anaesthesia when xylazine-ketamine combination was administered was 202.5 ± 7.62 min. According to Samour et al. (1984) it was 45.5 ± 15.0 min. The longer duration observed in the present study could be because of the higher dose of the drugs used in this combination. The duration of anaesthesia was maximum when xylazine-ketamine combination was used and minimum when ketamine alone was used.

The duration of recovery when xylazine alone was administered was 99.9 ± 5.70 min. According to Samour et al. (1984) in 11 species of birds the recovery period was prolonged. The duration of recovery when ketamine alone was administered was 97.5 ± 4.66 min. The recovery was

characterized by fluttering of wings and torticollis. Boever and Wright (1975) in chicken, owls, hawks and other larger birds, McGrath et al. (1984) in chicken and Samour et al. (1984) in 135 species of birds reported flapping of the wings during recovery. The duration of recovery when xylazine-ketamine combination was administered was 73.8 ± 3.19 min. Recovery was smooth and uneventful. This is in agreement with the observations of Samour et al. (1984) in 11 species of birds.

There was a significant fall in the temperature in all the sub-groups during anaesthesia which became near normal by 24 hours (Fig.25). This is in agreement with the observations of Lee (1953) in geese, ducks and chicken, Boever and Wright (1975) in chicken, hawks and other larger birds, Gandini et al. (1984) in ostriches, Christensen et al. (1987) in domestic fowl, Gonder and Barnes (1989) in turkeys and Devanand (1991) in chicken and ducks.

There was significant reduction in the respiration rate during anaesthesia in sub-groups A and C which became near normal by 24 hours (Fig. 26). This is in agreement with the observations of Samour et al. in six species of birds, Ludders et al. (1989) in Pekin ducks, Doolen and Jackson (1991) in caged birds, Matthews et al. (1991) and Cornick and Jensen (1992) in ostriches. When ketamine alone was

administered, there was significant reduction in the respiration rate upto 135 min. but significant increase was seen at 150 min. and at the third hour which reached near normal by 24 hours (Fig.26). Devanand (1991) reported an initial rise followed by a gradual reduction in the respiration rate in chicken and ducks.

There was significant decrease in the total erythrocyte count in sub-groups B and C at 10 min. and at 24 hours which became near normal by the fifth day. In sub-group A there was no significant decrease in the count (Fig.27). This is in agreement with the earlier findings of Soliman et al. (1965), Nara et al. (1979) and Sharma et al.. (1983a & b) in dogs, Kumar et al. (1974) in sheep, Kumar and Sharma (1986) in buffaloes, Pfeil and Duesterberg (1987) in cats and Devanand (1991) in chicken and ducks.

There was significant decrease in the leukocyte count in all the sub-groups at 10 min. all of which became near normal by the fifth day (Fig.28). Similar findings were reported by Soliman (1965), Nara et al. (1979) and Sharma et al. (1983a & b) in dogs, Kumar et al. (1974) in sheep, Kumar and Sharma (1986) in buffaloes, Pfeil and Duesterberg (1987) in cats and Devanand (1991) in chicken.

The lymphocyte count recorded significant decrease at

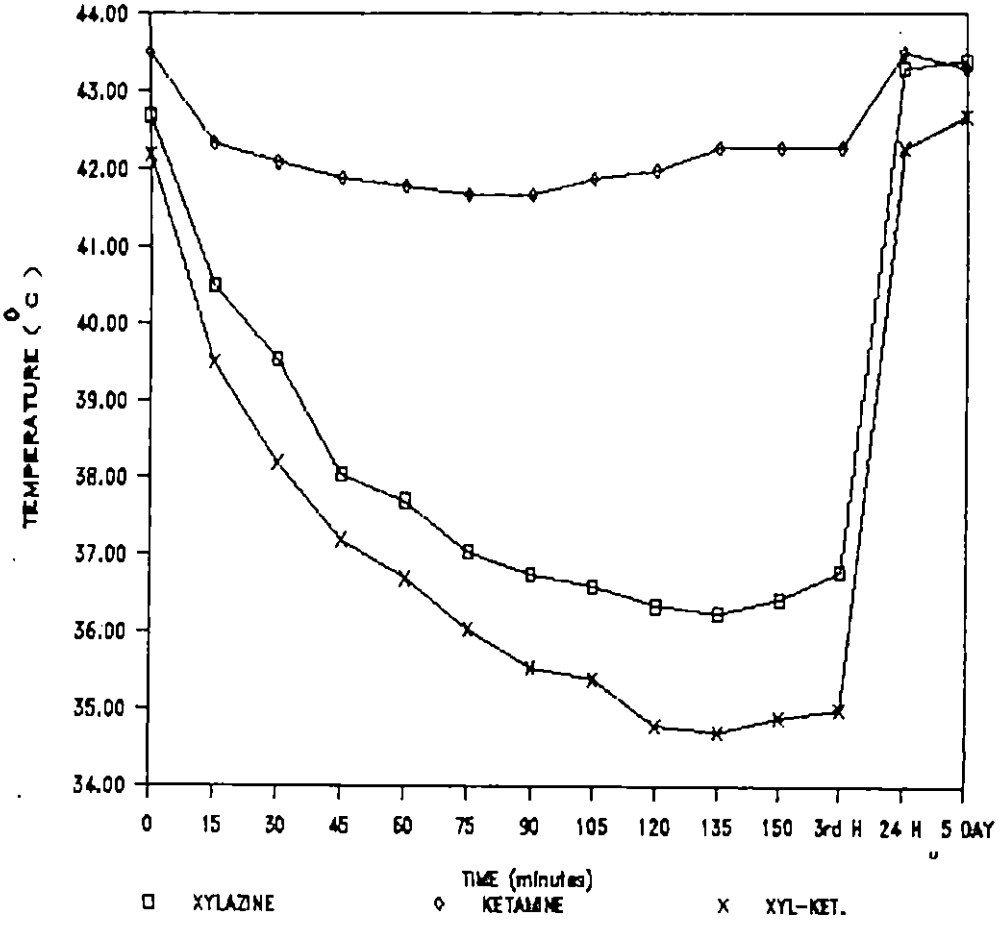
10 min. and 24 hours in sub-group A, at 10 min. and fifth day in in sub-group B and 10 min., 24 hours and on the fifth day in sub-group C (Fig.29). There was significant increase in the heterophil count at 10 min. in all the sub-groups all of which became near normal by the fifth day (Fig.30). There was significant increase in the eosinophil count at 10 min., 24 hours and on the fifth day in sub-groups B and C. In sub-group A, the count was significant at 24 hours and on the fifth day (Fig.31). According to Soliman et al. (1965) and Nara et al. (1979) in dogs and Devanand (1991) in chicken and ducks there was a decrease in the lymphocyte count and an increase in the heterophil count. Devanand (1991) in chicken and ducks reported an increase in the eosinophil count. While Soliman et al. (1965) reported a decrease in the eosinophil count in dogs.

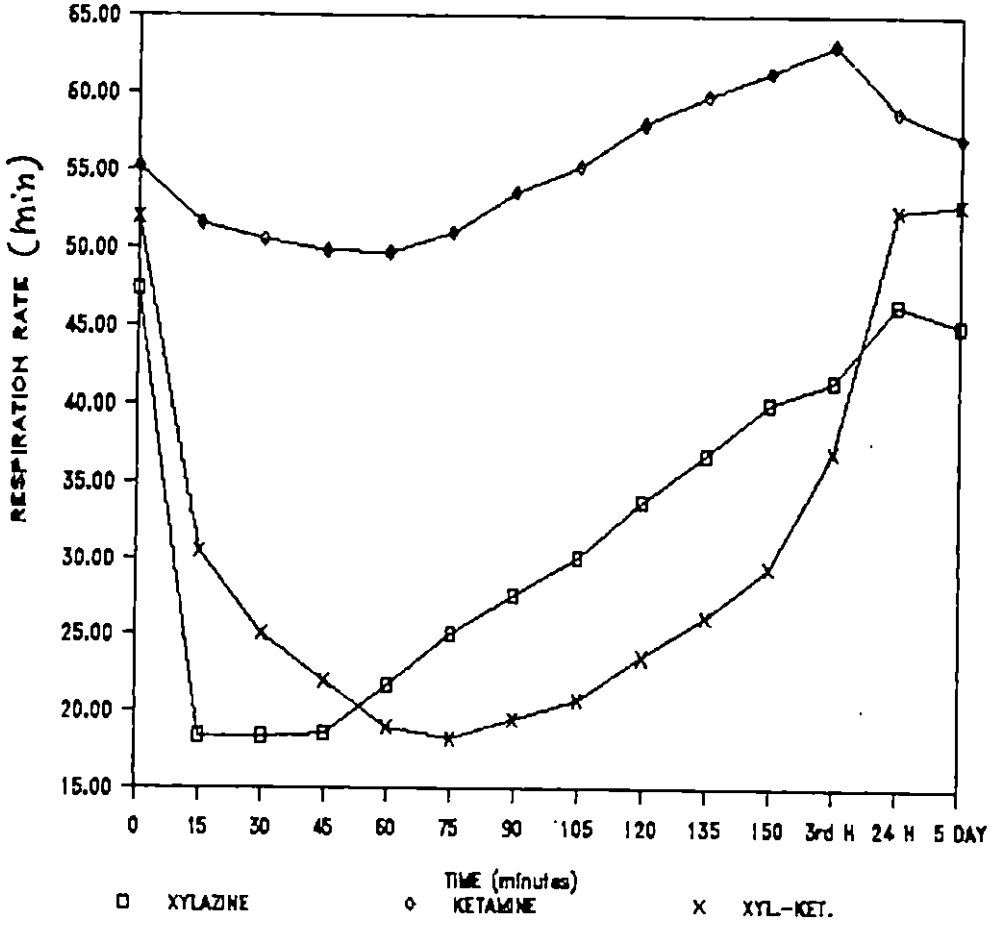
There was no significant variation in the monocyte count in all the sub-groups. Devanand (1991) reported that there was no variation in the count in chicken and ducks. Pfeil and Deusterberg (1987) recorded a reduction in the monocyte count in cats.

There was no significant variation in the basophil count in all the sub-groups. Devanand (1991) reported that there was no variation in the basophil count in chicken and

Fig.25 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on temperature in quails

Fig.26 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on respiration rate in quails


44.00
43.00
42.00
41.00
40.00
39.00
38.00
37.00
36.00
35.00
34.00
TEMPERATURE (°C)
0 15 30 45 60 75 90 105 120 135 150 3rd H 24 H 5 DAY
TIME (minutes)
XYLAZINE
KETAMINE
XYL-KET.


65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
RESPIRATION RATE (/min)
0 15 30 45 60 75 90 105 120 135 150 3rd H 24 H 5 DAY
TIME (minutes)
XYLAZINE
KETAMINE
XYL-KET.

ducks. According to Soliman et al. (1965) there was a reduction in the count in dogs.

Reduction in the haemoglobin content was observed in all the sub-groups but it was significant at 10 min. and at 24 hours in sub-groups B and C and at 10 min. in sub-group A all of which became near normal by the fifth day (Fig.32). Reduction in the haemoglobin content had been recorded by Soliman et al. (1965), Nara et al. (1979) and Sharma et al. (1983a & b) in dogs, Kumar et al. (1974) in sheep, Pfeil and Deusterberg (1987) in cats and Devanand (1991) in chicken and ducks.

In all the sub-groups, no responses were noticed on incising and suturing the skin and the wall of the crop but for body movements on manipulating the crop in sub-group A.

Mild fatty changes in the liver and congestion on the surface of the kidneys were observed in all the sub-groups. No tissue reaction was observed at the point of entry of the needle.

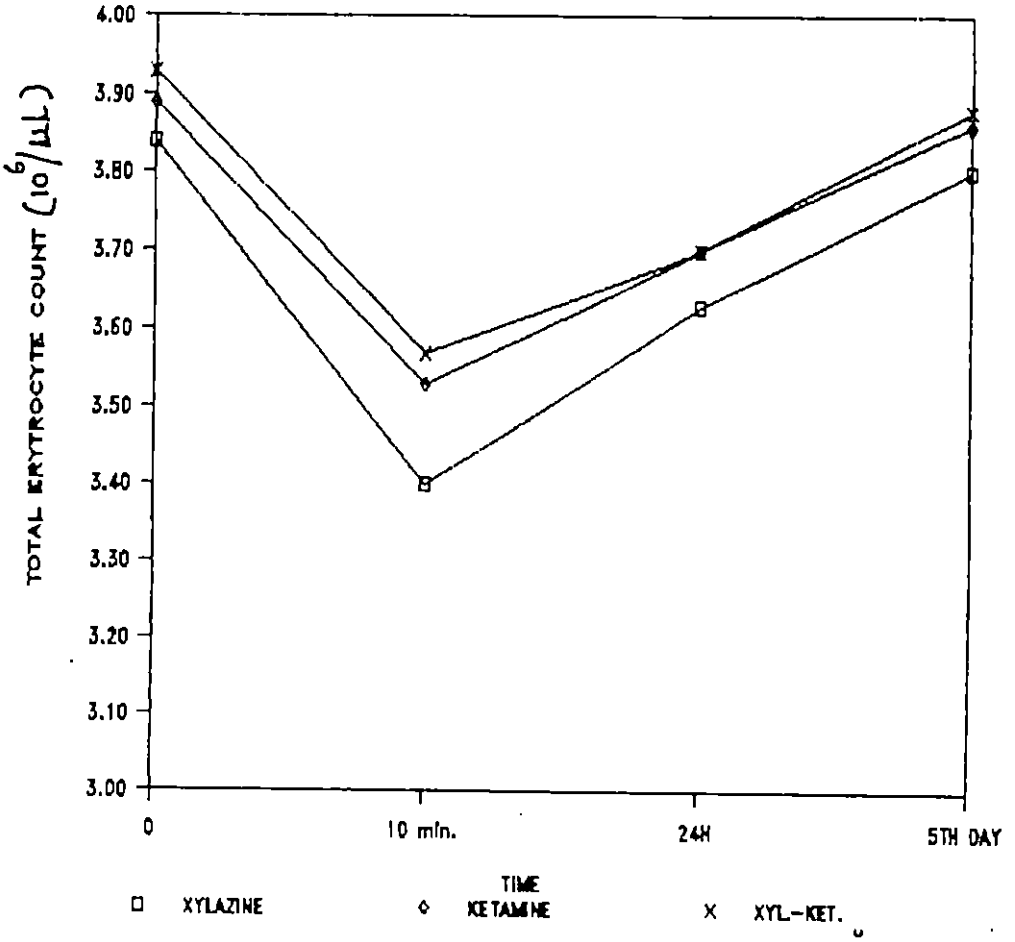
From the results of the present study, it was observed that the intraperitoneal administration of xylazine at the rate of 10 mg per kg bodyweight resulted in satisfactory anaesthesia in pigeons and light anaesthesia in quails.

Ketamine alone at the rate of 150 mg per kg bodyweight and xylazine at the rate of 5.0 mg per kg bodyweight followed by ketamine at the rate of 75 mg per kg bodyweight resulted in satisfactory anaesthesia in pigeons and quails.

For anaesthetising pigeons and quails a combination of xylazine and ketamine is recommended because of the short time for induction, long duration of anaesthesia and quick recovery.

Fig.27 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on total erythrocyte count in quails

Fig.28 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on total leukocyte count in quails


TOTAL ERYTROCYTE COUNT ($10^6/\mu L$)
4.00
3.90
3.80
3.70
3.60
3.50
3.40
3.30
3.20
3.10
3.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL-KET.

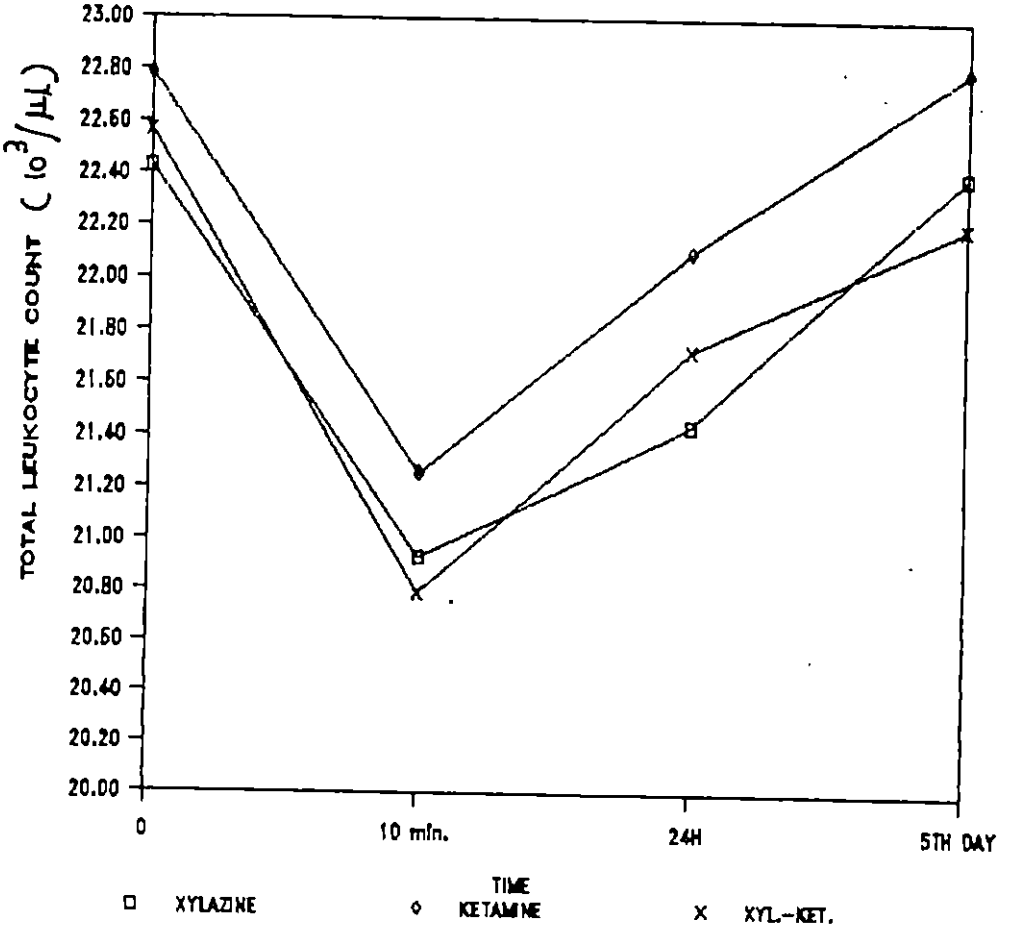
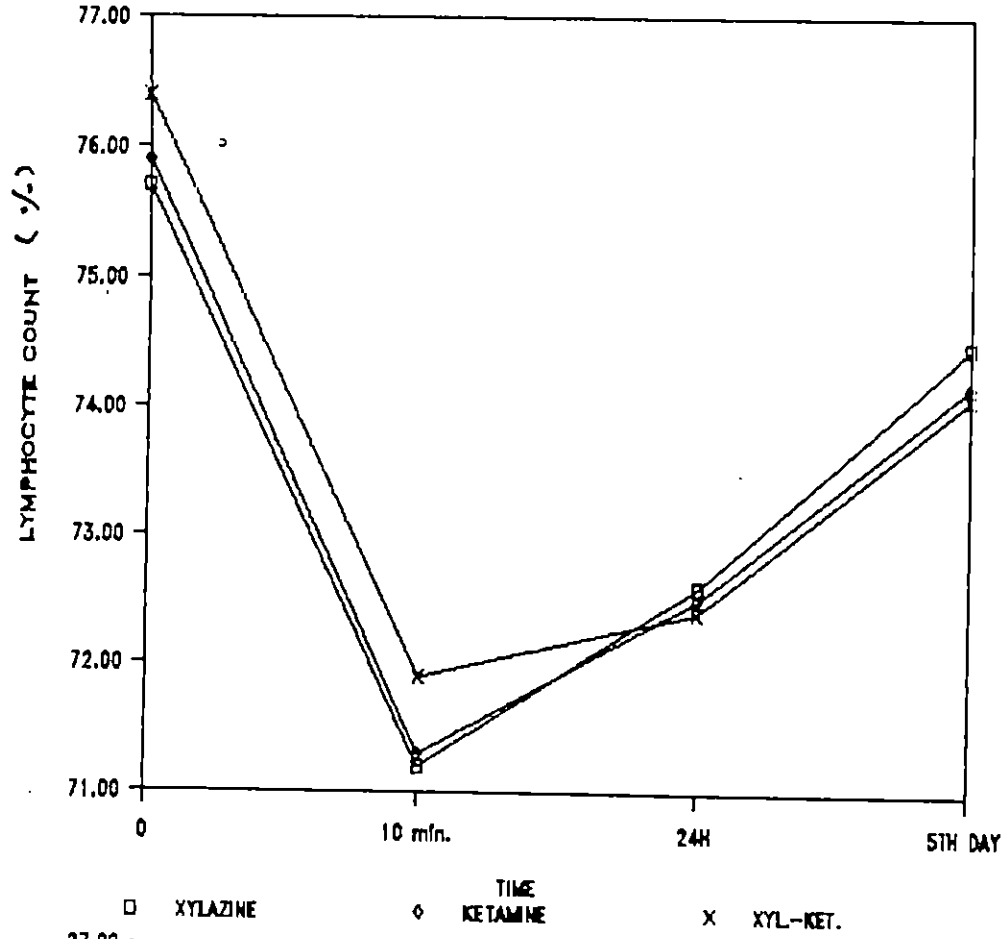

TOTAL LEUKOCYTE COUNT ($10^3/\mu L$)
23.00
22.80
22.60
22.40
22.20
22.00
21.80
21.60
21.40
21.20
21.00
20.80
20.60
20.40
20.20
20.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.

Fig.29 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on lymphocyte count in quails

Fig.30 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on heterophil count in quails


77.00
76.00
75.00
74.00
73.00
72.00
71.00
LYMPHOCYTE COUNT (%)
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.

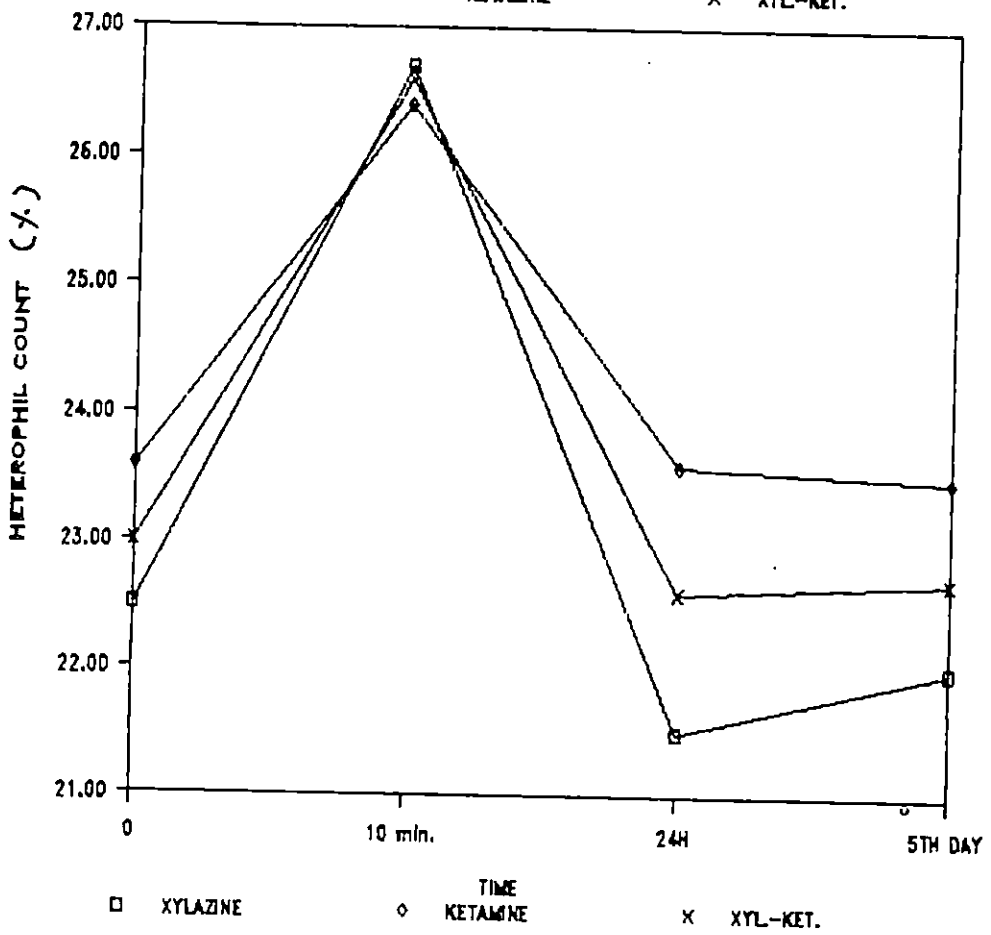
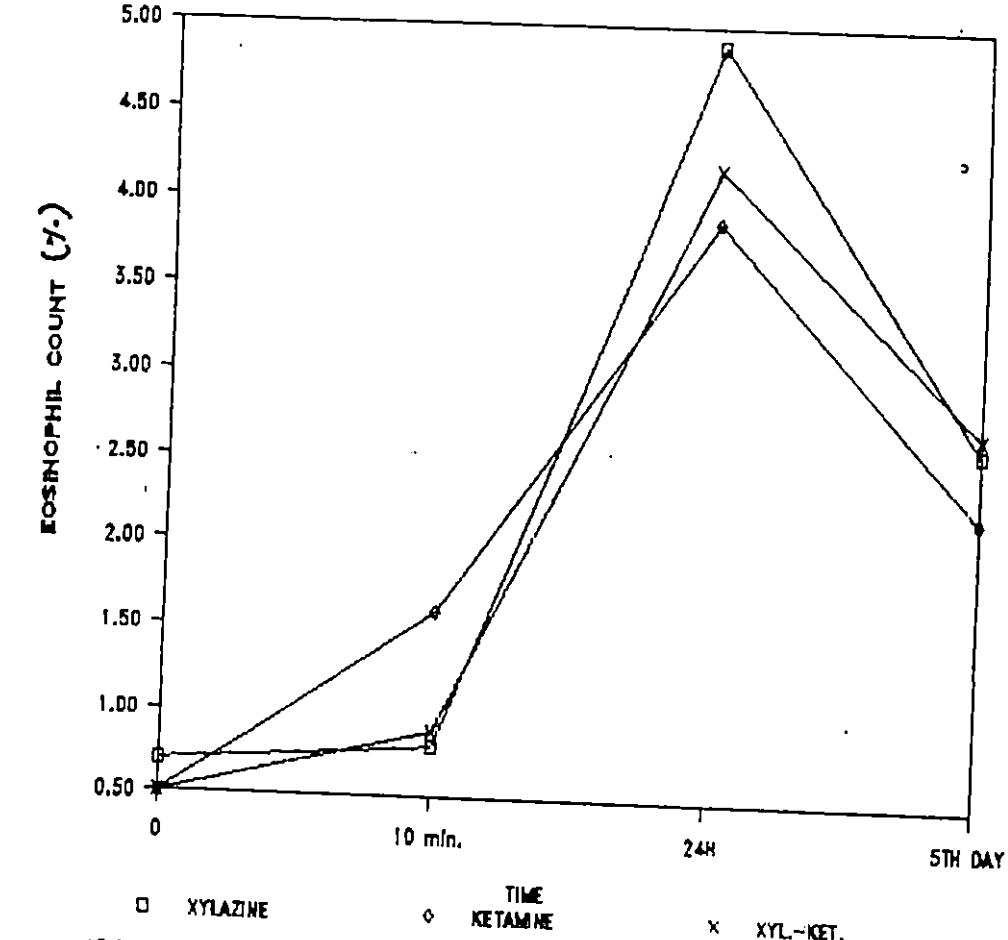
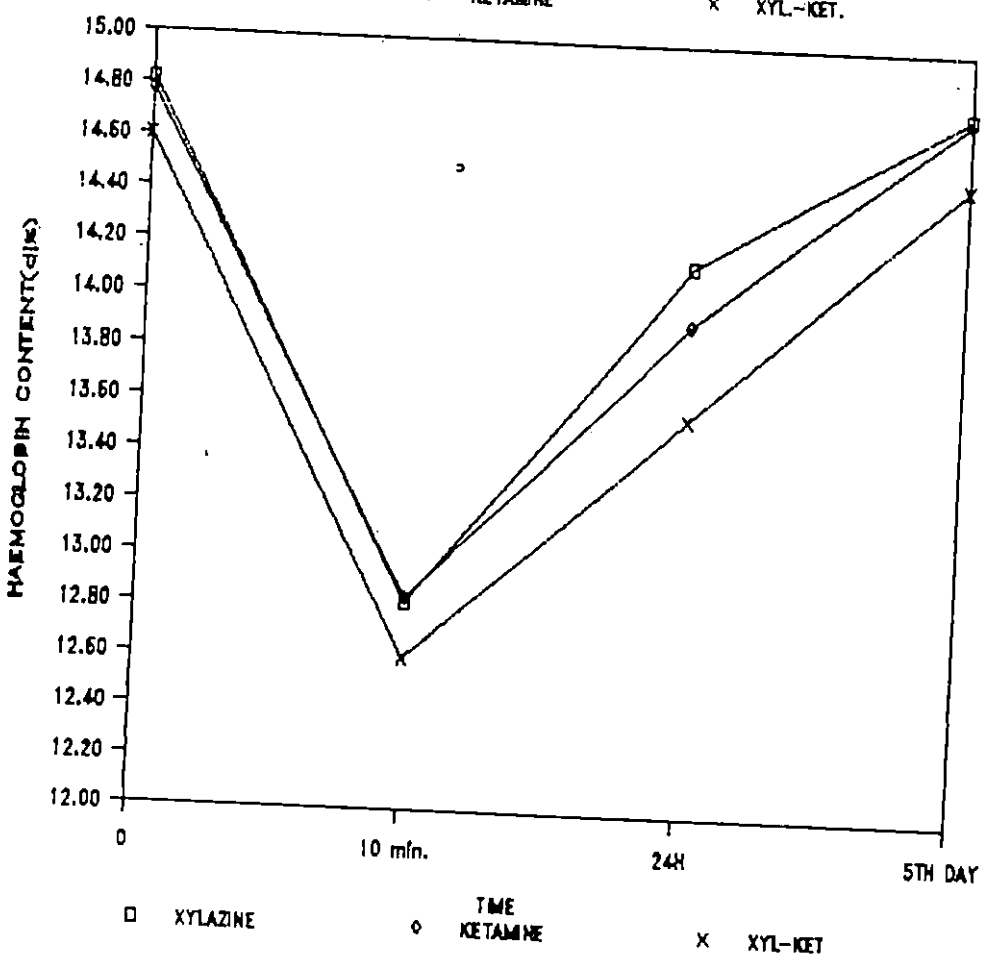

27.00
26.00
25.00
24.00
23.00
22.00
21.00
HETEROPHIL COUNT (%)
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.

Fig.31 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on eosinophil count in quails

Fig.32 Graph showing the effects of intraperitoneal administration of xylazine, ketamine hydrochloride and xylazine followed by ketamine hydrochloride on haemoglobin content in quails


EOSINOPHIL COUNT (%)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL.-KET.


HAEMOGLOBIN CONTENT(g%)
15.00
14.80
14.60
14.40
14.20
14.00
13.80
13.60
13.40
13.20
13.00
12.80
12.60
12.40
12.20
12.00
0
10 min.
24H
5TH DAY
TIME
XYLAZINE
KETAMINE
XYL-KET

Summary

SUMMARY

The study was conducted in 30 pigeons (Group I) and 30 quails (Group II), divided into three sub-groups viz. A, B, and C each consisting of ten birds. The bodyweight of pigeons were 141.00 ± 2.21, 176.00 ± 13.51 and 140.00 ± 4.69 g and that of quails were 145.00 ± 3.05, 144.70 ± 6.66 and 137.10 ± 2.46 g in sub-groups A, B and C respectively.

The drugs were administered intraperitoneally in all the sub-groups at the rate of (i) Xylazine 10 mg per kg bodyweight in sub-group A, (ii) ketamine hydrochloride 150 mg per kg body weight in sub-group B and (iii) xylazine 5.0 mg per kg bodyweight followed by ketamine hydrochloride 75 mg per kg bodyweight in sub-group C.

During the onset of anaesthesia, loss of balance, ruffled feathers, sitting posture, recumbency, abolition/sluggishness of pedal reflex were observed in Groups I and II. In addition dropping of wings was noticed in sub-group II A, torticollis and loss of righting reflex in sub-groups I B and II B, fluttering and dropping of wings and dropping of beak in sub-group I B, dropping of wings, torticollis, loss of righting reflex in sub-group I C and II C and fluttering of wings and dropping of beak in sub-group II C.

Corneal reflex, palpebral reflex and third eyelid movement persisted during anaesthesia. Eyes remained closed in both pigeons and quails during anaesthesia.

The time for induction was 12.70 ± 0.40 min., 7.60 ± 0.42 min. and 6.80 ± 0.34 min. in sub-groups A, B and C respectively in pigeons and 13.10 ± 0.43 min., 5.50 ± 0.15 min. and 8.30 ± 0.31 min. in sub-groups A, B and C respectively in quails.

The duration of anaesthesia was 47.70 ± 1.54 min., 37.80 ± 2.88 min. and 62.00 ± 1.15 min. in sub-groups A, B and C respectively in pigeons and 80.40 ± 1.96 min., 99.90 ± 2.86 min. and 202.50 ± 7.62 min. in sub-groups A, B and C respectively in quails.

The duration of recovery was 164.80 ± 2.82 min., 87.70 ± 2.98 min. and 85.10 ± 2.72 min. in sub-groups A, B and C respectively in pigeons and 99.90 ± 5.70 min., 97.50 ± 4.66 min. and 73.80 ± 3.19 min. in sub-groups A, B and C respectively in quails.

Significant reduction in the temperature was observed during anaesthesia in all the subgroups. Respiration rate showed significant decrease during anaesthesia in all the three subgroups in pigeons and sub-groups A and B in quails whereas no significant reduction in respiration rate was

observed with ketamine hydrochloride in quails upto 135 min. However, significant increase was noticed at 150 min. and the third hour.

Significant decrease in the total erythrocyte count was observed in all the subgroups except in sub-group I A, wherein no significant variation in the count was noticed.

Significant decrease in the total leukocyte count was observed in all the subgroups except subgroup II A where no significant variation in the count was observed.

Significant reduction in the lymphocyte count was observed in all the subgroups. Significant increase in the heterophil count was observed in sub-groups I C, II A, II B and II C but there was significant decrease in sub-group I B, and there was no significant variation in sub-group I A. Significant increase in the eosinophil count was seen in all the subgroups.

The haemoglobin content was significantly reduced in groups I and II.

Incising and suturing the skin and the wall of the crop did not evince any response but slight body movement was observed in sub-group II A.

Mild fatty changes in the liver and congestion on the surface of the kidneys were observed in all the birds of both the groups.

From the results of the present study, it was observed that:

(1) Intraperitoneal administration of xylazine alone, ketamine hydrochloride alone and xylazine followed by ketamine hydrochloride in the doses used, produced satisfactory anaesthesia in pigeons and quails.

(2) A combination of xylazine and ketamine hydrochloride is advantageous for anaesthesia in pigeons and quails because of the short time for induction, long duration of anaesthesia and quick recovery.

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ABSTRACT

The present study was undertaken to assess the efficacy of (i) xylazine, (ii) ketamine hydrochloride and (iii) xylazine followed by ketamine hydrochloride, for anaesthetizing pigeons and quails. The study was conducted in 30 pigeons (Columba livia) weighing 120-260 g and 30 quails (Coturnix coturnix japonica) weighing 120-180 g. The birds were divided into two groups, Group I (30 pigeons) and Group II (30 quails). Groups I and II were further divided into three sub-groups, viz., A, B and C, each consisting of 10 birds.

The drugs were administered intraperitoneally in all the sub-groups at the rate of (i) Xylazine 10 mg per kg bodyweight in sub-group A, (ii) ketamine hydrochloride 150 mg per kg body weight in sub-group B and (iii) xylazine 5.0 mg per kg bodyweight followed by ketamine hydrochloride 75 mg per kg bodyweight in sub-group C.

During the onset of anaesthesia, loss of balance, ruffled feathers, sitting posture, recumbency, abolition/sluggishness of pedal reflex were observed in Groups I and II. In addition dropping of wings was noticed in sub-group II A, torticollis and loss of righting reflex in

sub-group I B and II B, fluttering and dropping of wings and dropping of beak in sub-group I B, dropping of wings, torticollis, loss of righting reflex in sub-group I C and II C and fluttering of wings and dropping of beak in sub-group II C.

Corneal reflex, palpebral reflex and third eyelid movement persisted during anaesthesia. Eyes remained closed in both pigeons and quails during anaesthesia.

The time for induction was 12.70 $\pm$ 0.40 min., 7.60 $\pm$ 0.42 min. and 6.80 $\pm$ 0.34 min. in sub-groups A, B and C respectively in pigeons and 13.10 $\pm$ 0.43 min., 5.50 $\pm$ 0.15 min. and 8.30 $\pm$ 0.31 min. in sub-groups A, B and C respectively in quails.

The duration of anaesthesia was 47.70 $\pm$ 1.54 min., 37.80 $\pm$ 2.88 min. and 62.00 $\pm$ 1.15 min. in sub-groups A, B and C respectively in pigeons and 80.40 $\pm$ 1.96 min., 99.90 $\pm$ 2.86 min. and 202.50 $\pm$ 7.62 min. in sub-groups A, B and C respectively in quails.

The duration of recovery was 164.80 $\pm$ 2.82 min., 87.70 $\pm$ 2.98 min. and 85.10 $\pm$ 2.72 min. in sub-groups A, B and C respectively in pigeons and 99.90 $\pm$ 5.70 min., 97.50 $\pm$ 4.66 min. and 73.80 $\pm$ 3.19 min. in sub-groups A, B and C respectively in quails.

Significant reduction in the temperature was observed during anaesthesia in all the subgroups. Respiration rate showed significant decrease during anaesthesia in all the three subgroups in pigeons and sub-groups A and C in quails whereas no significant reduction in respiration rate was observed with ketamine hydrochloride in quails upto 135 min. However, significant increase was noticed at 150 min. and the third hour.

Significant decrease in the total erythrocyte count was observed in all the subgroups except in sub-group I A, wherein no significant variation in the count was noticed.

Significant decrease in the total leukocyte count was observed in all the subgroups except subgroup II A where no significant variation in the count was observed.

Significant reduction in the lymphocyte count was observed in all the subgroups. Significant increase in the heterophil count was observed in sub-groups I C, II A, II B and II C but there was significant decrease in sub-group I B, and there was no significant variation in sub-group I A. Significant increase in the eosinophil count was seen in all the subgroups.

The haemoglobin content was significantly reduced in groups I and II.

Incising and suturing the skin and the wall of the crop did not evince any response but slight body movement was observed in sub-group II A.

Mild fatty changes in the liver and congestion on the surface of the kidneys were observed in all the birds of both the groups.