

A comparison of the clinical effects associated with xylazine, ketamine, and a xylazine-ketamine cocktail in pigeons (*Columba livia*)

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Abstract: A study was conducted to compare the clinical effects of xylazine, ketamine, and a cocktail of them in pigeons (*Columba livia*). For this study 15 adult and healthy pigeons were divided into 3 equal groups: A - xylazine (16 mg/kg), B - ketamine (60 mg/kg) and C - xylazine-ketamine cocktail (8 mg/kg + 30 mg/kg, respectively). All treatments were administered intramuscularly. Onset of action was smooth with a mean time of onset of 13.4 ± 2.78 min, 11 ± 1.49 min, and 1.6 ± 0.51 min, respectively. In group A and B light sedation and a light plane of anaesthesia were achieved, respectively, accompanied by superficial analgesia. Group C birds showed deep anaesthesia accompanied by profound analgesia. Hypothermia, respiratory depression (due to intercostals muscle relaxation and hypothermia) and bradycardia persisted until recovery in groups A and C, while birds in group B showed hyperthermia, tachycardia, and shallow respiration. The effects persisted for 33.7 ± 5.94 min, 47.7 ± 8.06 min, and 112.9 ± 36.51 min, with a recovery period of 65.9 ± 22.22 min, 52.6 ± 9.64 min, and 96.2 ± 19.06 min, for groups A, B, and C, respectively. Recovery was rough in group B and smooth in groups A and C. Results of the study suggested that in pigeons the use of xylazine (alone) is safe for handling and less painful procedures while a xylazine-ketamine cocktail is a suitable anaesthesia for painful procedures at the dosages used in the study. Ketamine alone is not recommended for anaesthesia in pigeons.

Key words: Xylazine-ketamine cocktail, sedatives, anaesthetics, analgesic, pigeons

Introduction

Alpha-2-adrenergic agonists are in common use as sedative and analgesic agents for avian species because they are considered easy to administer and show consistent effects. Lees (1) reported that xylazine is a potent, non-narcotic sedative, muscle relaxant, and analgesic. Mostachio et al. (2) reported that the intramuscular injection of xylazine smoothly induces

loss of righting reflex and response to painful stimulus in leghorn roosters. Freed and Baker (3) reported that xylazine, detomidine, and medetomidine are usually used in combination with ketamine. Maiti et al. (4) conducted research on different combinations of ketamine hydrochloride and reported that a xylazine-ketamine combination is the best anaesthesia for surgical intervention in chickens. Mostachio et al. (2)

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also reported that a xylazine and ketamine combination induces hypothermia, bradycardia, and respiratory depression. Heaton and Brauth (5) stated that a detomidine-ketamine combination results in a reduction of required doses, smooth induction and recovery, and better muscle relaxation. Valvered et al. (6) concluded that ketamine is rarely used alone because it is associated with poor muscle relaxation, muscle tremors, myotonic contractions, opisthotonus, and rough recoveries. The drug may be administered alone but is more commonly used together with either alpha-2-adrenergic drugs, diazepam or azaperone, depending on the species involved. The purpose of this study was to compare the clinical effects in pigeons of a xylazine-ketamine cocktail with individual sedative and anaesthetic doses of xylazine and ketamine, respectively. Individual drug doses were selected for comparison at twice the dosages used in the cocktail.

Materials and methods

Bird selection

Fifteen healthy adult pigeons (*Columba livia*) of either sex (5 males and 10 females) were purchased from the local market (Lahore, Pakistan). Their body weight ranged from 150 to 300 g. All pigeons belonged to the same flock and their age was between 1 and 3 years. All birds were examined closely to judge their health status before the commencement of the trial. This included recording of body weight, temperature, respiration and heart rates, different body reflexes, and looking for presence of any injury. Only healthy and active birds were used. Male and female pigeons were kept separately in 3 separate cages (five birds/cage sized 86 × 76 × 86 cm) in the Pet Centre, University of Veterinary and Animal Sciences, Lahore, Pakistan. The birds were kept in a clean and stress-free environment at 25 °C. All birds were maintained on a nutritional regimen allowing the water and feed ad libitum.

Experimental design

Water and food of all birds were withheld 30 min prior to drug administration to minimise the chances of vomiting. Pigeons were randomly divided into 3 equal groups: A (2 males and 3 females) - xylazine (16 mg/kg), B (1 male and 4 females) - ketamine (60

mg/kg), and C (2 males and 3 females) - xylazine-ketamine cocktail (8 mg/kg + 30 mg/kg, respectively). All treatments were administered intramuscularly using a 1 mL insulin syringe [2% Injection Xylaz[®] (xylazine) by Farvet; 5% Injection Calypsol[®] (ketamine) by Medimpex].

Induction period (time interval between drug administration and complete onset of sedation/anaesthesia), duration of sedation or anaesthesia, recovery period (time interval between disappearance of first sign of sedation/anaesthesia until complete recovery), degree and duration of analgesia (by giving superficial and deep painful pinching or pricking stimulus on different body parts), body reflexes (righting reflex, toe pinch reflex, feather plucking reflex, palpebral reflex, table knock reflex [alert response elicited on knocking the table carrying bird]), body temperature via the rectum using a digital thermometer, respiration from sternal movements, and heart rate by stethoscope from the left costal area were recorded at 10 min intervals.

Statistical analysis

The data thus obtained, was subjected to the statistical analysis for one way analysis of variance and statistical difference among the various treatments was determined by least significant difference (L.S.D) test. Difference was considered to be significant at 5% level.

Results

Times for onset of action, duration of effect, duration of analgesia, and recovery period are found in the Table. Following xylazine injection all birds remained active during the first 5 min followed by standing quietly after this time. Xylazine sedation was smooth but light in all birds except one bird that showed shivering and vomiting. All birds remained sitting with their eyes closed when undisturbed. Ketamine resulted in all birds maintaining normal activity during the initial 3-4 min and then a smooth onset of drowsiness with standing quietly after this time and then movement into stage II anaesthesia with dorsal recumbancy. Eyes of all birds were closed during initial 10 min of anaesthesia and then opened. Analgesia following both xylazine and ketamine was only mild and limited to the dermis. The xylazine-

Table. Times (min) for onset of action, duration of effect, duration of analgesia, and recovery period in xylazine treated birds (A), ketamine treated birds (B), and xylazine-ketamine cocktail treated birds (C).

Groups	Onset	Duration	Recovery	Analgesia
A	13.4 ± 2.78 ^a	33.7 ± 5.94 ^a	65.9 ± 22.22 ^a	30 ± 5.66 ^a
B	11 ± 1.49 ^b	47.7 ± 8.06 ^b	52.6 ± 9.64 ^a	45.5 ± 4.95 ^a
C	1.6 ± 0.51 ^c	112.9 ± 36.51 ^c	96.2 ± 19.06 ^b	105 ± 3.54 ^c

*Values having different superscripts are significantly different from each other ($P < 0.5$).

ketamine cocktail rapidly and smoothly induced an anaesthetic state that would be appropriate for major surgical procedures, as evidenced by the degree of analgesia achieved.

In xylazine treated birds recovery was smooth but slow. In ketamine treated birds recovery was very rough due to lack of skeletal muscle relaxation causing excitement and multiple attempts to attain normal posture. In the xylazine-ketamine cocktail treated birds recovery was smooth. Only one bird showed vomiting 10 min after recovery started.

Other observations

In xylazine treated birds except feather plucking reflex all reflexes were present. In ketamine treated birds only righting reflex, feather plucking reflex, and table knock reflex were absent, while in xylazine-ketamine treated birds there was a complete absence of all reflexes.

Xylazine and the xylazine-ketamine cocktail caused hypothermia, while ketamine treated birds showed hyperthermia. Both hypothermia and hyperthermia remained until recovery or shortly thereafter. Body temperature decreased for the first 140 and 100 min in groups A and C, respectively. In group B there is an increase in body temperature for 60 min with evidence of hyperthermia even at complete recovery.

Xylazine, ketamine, and the xylazine-ketamine cocktail elicited respiratory depression in all birds that persisted until recovery.

Xylazine and xylazine-ketamine cocktail treated birds showed bradycardia while ketamine treated birds suffered tachycardia.

No other untoward effect of treatments was observed. No mortality occurred in any group. All attained their normal physiological status after 24 h.

Discussion

In avian species 2 techniques are recommended for sedation and anaesthesia: inhalational and parenteral. The inhalational technique typically involves the use of isoflurane or sevoflurane, while parenteral methods utilise intravenous, intramuscular, or subcutaneous administration of injectable drugs (xylazine, medetomidine, detomidine, ketamine, chloral hydrate, barbiturates, butorphanol, and phenothiazines). Freed and Baker (3) reported that xylazine, detomidine, and medetomidine are usually combined with ketamine in birds and administered intramuscularly or intravenously. The alpha-2-adrenergic agonists provide muscle relaxation, analgesia, and sedation and smooth induction and recovery. They suppress pain arising superficially and also visceral pain.

Ketamine is rarely advised for use alone in birds. According to the findings reported by Athar et al. (7), ketamine has a wide safety margin with up to 10 times the usual dose normally required for toxicity. Although respiratory depression may occur following toxicity, supportive ventilation and administration of doxapram are suggested in such cases. However, myoclonic jerking is an adverse complication commonly associated with ketamine. It can be controlled by ultra-short-acting barbiturates, diazepam, or midazolam, but the use of combinations to avoid this effect is preferable. The objective of the

present study was to compare the synergistic effects of a xylazine-ketamine cocktail for anaesthesia with individual sedative and anaesthetic doses of xylazine and ketamine. Our results show that the effects are enhanced and smoothed by the combination. Similar to the observations reported by Hoffman (8) and Salonen (9), xylazine induction of sedation was slow but smooth, and associated with superficial analgesia and good muscle relaxation in all birds. During sedation all birds suffered respiratory depression, bradycardia, and hypothermia. The same observations were reported by Sandmeier (10), who conducted an experiment on the evaluation of an alpha-2-adrenergic agonist medetomidine for short-term immobilisation of domestic pigeons and Amazon parrots. All our birds also showed smooth recovery from xylazine sedation in accordance with the findings reported by Salonen (9).

In ketamine treated birds there was a slow but smooth induction of anaesthesia. Ketamine induced a very light anaesthesia with poor muscle relaxation, superficial analgesia, and absence of all reflexes except palpebral reflex and pharyngeal reflex. These observations are similar to those reported by Samour et al. (11) and Lumeij and Deenik (12). During ketamine anaesthesia respiration was slow but regular in all birds and there was tachycardia and

hyperthermia that persisted until complete recovery. These findings are in agreement with Mohammad et al. (13) and Shakoor et al. (14). As noted in the report by Samour et al. (11) recovery was very rough in all birds due to dissociative characteristics of ketamine anaesthesia.

The xylazine-ketamine cocktail gave a very fast and smooth induction of anaesthesia associated with deep analgesia, good muscle relaxation, and absence of all reflexes. These findings are in agreement with the findings published by Krajka and Juranova (15). Shakoor et al. (14) also noted similar hypothermia, hypoventilation, and bradycardia throughout anaesthesia until complete recovery. Recovery was smooth in all our birds with some efforts to attain their normal sitting or standing posture. The same observations are reported by Mohammad et al. (13), who studied the effect of detomidine in combination with ketamine in chickens.

In conclusion, in pigeons, for handling and less painful procedures, xylazine (alone) can be used effectively and safely, while for painful procedures use of a xylazine-ketamine cocktail is more appropriate. Ketamine (alone) produces undesirable anaesthesia for pigeons at the dosage used, related primarily to the recovery phase, but also associated with hyperthermia.

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