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Full Length Research Paper

Medetomidine elicit variable effects on sedative indices, hematological and physiological parameters in domestic pigeons (*Columba livia*)

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The effects of graded doses of medetomidine (100, 150, 200 and 250 µg/kg) on hematology as well as physiological and sedative indices were evaluated in this study using domestic pigeons. Sedation ranging from sternal to lateral recumbency, as well as adequate muscle relaxation was observed. The longest sedative effect was observed using the highest dose which was statistically significant ($P < 0.05$) from the other doses used. The differences in sedative scores between the groups was significant ($P < 0.05$) when the doses were compared. Significant decrease ($P < 0.05$) from the baseline values was observed on the physiological parameters, likewise when the physiological parameters between the graded doses were compared. The packed cell volume (PCV) and red blood cell count (RBC) values show significant increase ($P < 0.05$) with increase dose, but the white blood cells (WBC) does not show significant changes. This make medetomidine to be a potent sedative agent that can be used successfully for routine surgical and clinical procedures and the doses has to be carefully selected to avoid some of the unwanted effects on the physiological as well as hematological values in pigeons.

Key words: Alpha-2-agonist, graded doses, hematology, pigeons, physiology, sedation.

INTRODUCTION

Alpha-2-adrenoreceptor agonists are mostly used in combination with opioids, dissociative anesthetics, or as pre-anesthetic sedatives that reduce the amount of anesthetic agent to be used. Over two decades, medetomidine has been described to exert a very potent α_2-adrenoreceptors affinity (Savola et al., 1986) where it acts as a full agonist (Virtanen et al., 1988). The α_2/α_1 selectivity ratio of this drug is about 1620; about 5 to 10 times higher than detomidine, clonidine, xylazine or other compounds with a similar mechanism of action. Medetomidine and other α_2-agonists are known to reduce stress and to have an anxiolytic effect (Jalanka, 1993; Thurmon et al., 1996). The use of gaseous anesthetics agents in birds is associated with a lot of cardiopulmonary complications. Studies and clinical applications of medetomidine in pigeons examine its application as an inductive agent or a free anesthetic agent in combination with other drugs like ketamine and midazolam (Pollock et al., 2001; Lumeij and Deenik 2003; Uzun et al., 2003). Previous studies reported elevation in blood pressure, decrease in heart rate, hypoventilation, hypoxemia and hypercapnia when xylazine and ketamine combination is used in different avian species (Raffe et al., 1993; Lumeij and Deenik 2003). In the same vein, the use of medetomidine-medazolam-ketamine combination proves unsafe in ducks (Machin and Caulket, 1998). Packed cell volume (PCV), hemoglobin concentration (Hb) and protein values are among the most important parameters in the assessment of health and diseases in birds and other mammals and PCV serves as a marker for hemogram specifically in determining the number of

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Table 1. Mean (±SD) time (min) elapsing before manifestation of sedation/recovery sign following medetomidine administration in pigeons (C. *livia*).

Parameter	Treatment groups			
	1	2	3	4
IND	4.17 ± 0.69	3.50 ± 0.50	3.83 ± 0.69	3.50 ± 0.50
DA	183.5 ± 6.50	193.5 ± 3.45	206.3 ± 2.92*	218.70 ± 3.94*
TFR	192.70 ± 5.99	197.00 ± 3.56	210.16 ± 2.73*	222.17.66 ± 4.06*

*Significantly different from treatment group 1 ($P < 0.05$), treatment 1 (100 µg/kg medetomidine), treatment 2 (150 µg/kg medetomidine), treatment 3 (200 µg/kg medetomidine) and treatment 4 (250 µg/kg medetomidine). IND, Induction time; DA, duration of action; TFR, time to full recovery. n = 6.

erythrocytes and circulating Hb (Hawkey et al., 1983, 1984; Benjamin, 1985). These factors necessitate the assessment of blood parameters and changes that may result when sedatives and other related drugs were used in birds and other animals. This study was designed to examine the effects of graded doses of medetomine as a possible sole agent for immobilization of pigeons in clinical procedures.

MATERIALS AND METHODS

Medetomidine (Domitor® Orion Famos, Pharmaceutical, animal health Finland) 1 mg/ml reconstituted into 1 mg/10 ml was used. Twenty four healthy domesticated pigeons of both sexes were acclimatized for two weeks before commencement of the experiment. They were fed with grains and groundnut, water was given *ad-libitum*. Four different doses of medetomidine at 100, 150, 200 and 250 µg/kg were used. Six pigeons were assigned to each of the earlier given doses.

The drug was injected into the deep pectoral muscle using tuberculin syringe. The sedative scores was evaluated using a criteria modified by Steffy (1983) with little amendments. Zero degree of sedation is the condition of the bird before drug administration, 1° sedation described a stage after the drug administration, the bird was able to stand up, partly responsive to environmental objects and walk voluntarily when stimulated. 2° of sedation is a stage where the bird is unable to stand and hardly responsive to environmental stimulations. 3° sedation signified a situation whereby the bird is unable to restore body position, and hardly has foot withdrawal response to needle pick and have good muscle relaxation. Stethoscope and a tally counter were used to obtain the heart and respiratory rates; while a digital thermometer was inserted into the cloacae to obtain the cloacal temperature per minute. These parameters were taken before the drug administration and at intervals of 15 min after the drug administration up to recovery period. The blood was obtained by needle puncture at the wing vein. Heparinize capillary tube was used directly to obtain blood and plasticine was used to cover the end of the tube before putting it into haematocrit centrifuging machine for PVC determination. Haemocytometer with counting chambers and a pipette were used to determine the white blood cells (WBC) and red blood cell count (RBC) values, respectively. These parameters were obtained before drug administration and at 10, 60, 150 min and 24 h, respectively. Mean ± standard deviation (SD) were determined and subjected to statistical analysis using Microsoft statistical package 2007 version where analysis of variance (ANOVA) was applied. Values for $P < 0.05$ where considered significant.

RESULTS AND DISCUSSION

The results of the study are summarized in Tables 1 to 5. Results in this study reveals that increasing the dose of medetomidine has no effect on the induction time (Table 1). The same effect was reported by Onifade and Ismaila (2009) using detomidine in pigeons; but a dose dependent effect on duration of action was observed using the drug. Other researchers also reported a dose-dependent duration of action in pigeons (Pollock et al., 2001; Uzun et al., 2003) and other domestic animals (Vanio and Palmu, 1989; Onifade, 2007). Alpha-2-agonist was known for its longer dose-dependent duration of effect. Higher doses of medetomidine (200 to 250 µg/kg) can be used successfully without any detrimental effect in pigeons. The sedative score (Figure 1) indicates that the drug has dose-dependent sedative effect giving the drug an advantage of using it alone for immobilization in these species without combining it with ketamine or narcotics. Dose-related decrease in physiological parameters observed using this drug was also observed by other researchers using medetomidine and other alpha-2-agonists in avian and other species. The overall outcome of this study shows that medetomidine can be used as a sole aesthetic agent for restrain and other minor surgical manipulations in avian clinics specifically in pigeons without producing detrimental or life threatening effects. The drug exhibits variable effects on physiological parameters where higher doses of the drug show significant decrease in both rectal temperature, respiratory and heart rate. Other studies also portray the same pattern of effects. This can be overcome by carefully choosing the lower or intermediate doses. From the results, the PCV and RBC values shows significant increase from the baseline values at 10 to 150 min for the PCV and even at 24 h for the RBC ($P < 0.05$) in a dose dependant manner. This might be due to a decrease in heart rate, an increase, then decrease in mean arterial pressure, which leads to a decrease in cardiac output and peripheral vasoconstriction, then followed by

Table 2. Mean (±SD) heart rates (beats/min) following medetomidine administration in pigeons (C. *livia*).

Time (min)	Treatment groups			
	1	2	3	4
0	218.67 ± 10.75	224.67 ± 18.58	231.33 ± 15.90	228.67 ± 13.74
15	128.00 ± 20.49^{+}	102.00 ± 30.00	118.67 ± 22.93^{+}	106.00 ± 10.71^{+}
30	103.33 ± 13.35^{+}	88.00 ± 15.66^{+}	99.33 ± 11.18^{+}	84.33 ± 12.88^{+}
45	90.00 ± 7.92^{+}	81.33 ± 11.47^{+}	80.67 ± 12.53^{+}	78.33 ± 11.57^{+}
60	79.67 ± 6.37^{+}	77.33 ± 9.71^{+}	78.67 ± 9.98^{+}	70.00 ± 7.21^{+}
75	82.33 ± 10.23^{+}	78.33 ± 6.29*$^{+}$	77.67 ± 6.97^{+}	73.00 ± 21.66^{+}
90	91.00 ± 14.64^{+}	103.00 ± 4.28*$^{+}$	84.67 ± 7.8^{+}	83.33 ± 21.59^{+}
105	111.00 ± 16.11^{+}	120.33 ± 8.52^{+}	94.00 ± 9.09*$^{+}$	102.67 ± 23.26^{+}
120	129.00 ± 22.79^{+}	125.67 ± 5.71	95.33 ± 14.49*$^{+}$	108.67 ± 21.34+
135	157.80 ± 34.87^{+}	137.33 ± 7.89+	116.00 ± 9.73*$^{+}$	130.33 ± 21.68^{+}
150	173.00 ± 25.97^{+}	164.00 ± 21.94^{+}	134.00 ± 13.67*$^{+}$	139.67 ± 22.93*
165	188.67 ± 22.17	183.67 ± 16.18	151.33 ± 18.99*$^{+}$	154.67 ± 26.69*
180	209.33 ± 11.41	195.33 ± 12.53	174.00 ± 14.24*$^{+}$	171.67 ± 25.62*
195	212.67 ± 12.89	204.33 ± 8.83	190.33 ± 16.10*$^{+}$	187.00 ± 17.43*
210	221.00 ± 14.13	212.00 ± 8.87	206.33 ± 4.53	208.33 ± 6.77
225	219.33 ± 12.74	216.67 ± 9.64	215.67 ± 3.73	213.67 ± 5.47
240	222.00 ± 11.31	222.67 ± 11.18	224.00 ± 5.03	221.33 ± 7.54

$^{+}$Significantly different from the baseline values ($P < 0.05$). *Significantly different from treatment group 1 ($P < 0.05$). Treatment 1 (100 µg/kg medetomidine), treatment 2 (150 µg/kg medetomidine), treatment 3 (200 µg/kg medetomidine) and treatment 4 (250 µg/kg medetomidine).

Table 3. Mean (±SD) respiratory rates (cycles/min) following medetomidine administration in pigeons (C. *livia*).

Time (min)	Treatment groups			
	1	2	3	4
0	64.00 ± 2.31	68.00 ± 5.66	65.33 ± 8.23	61.67 ± 6.37
15	38.33 ± 7.52^{+}	36.00 ± 9.24^{+}	40.00 ± 12.65^{+}	25.33 ± 6.99^{+}
30	32.00 ± 6.93^{+}	25.33 ± 5.96^{+}	27.33 ± 3.59^{+}	18.33 ± 8.52*$^{+}$
45	26.00 ± 3.83^{+}	23.33 ± 4.27^{+}	24.00 ± 2.31^{+}	16.33 ± 6.97*$^{+}$
60	24.00 ± 4.00^{+}	21.33 ± 1.89^{+}	23.33 ± 3.59^{+}	20.67 ± 2.75^{+}
75	23.33 ± 2.75^{+}	20.67 ± 1.49^{+}	23.33 ± 2.75^{+}	20.67 ± 2.75^{+}
90	25.33 ± 3.77^{+}	22.00 ± 2.00^{+}	17.67 ± 7.16*$^{+}$	22.00 ± 2.00^{+}
105	29.33 ± 5.12^{+}	25.33 ± 3.77^{+}	24.00 ± 2.31^{+}	23.33 ± 3.59^{+}
120	30.00 ± 5.16^{+}	27.00 ± 5.13^{+}	24.67 ± 1.49^{+}	25.33 ± 3.59^{+}
135	35.33 ± 4.42^{+}	26.33 ± 10.48^{+}	26.67 ± 5.49^{+}	26.33 ± 2.92^{+}
150	39.67 ± 7.87^{+}	36.33 ± 3.14^{+}	29.00 ± 3.96*$^{+}$	30.00 ± 3.06*$^{+}$
165	45.67 ± 7.25	39.67 ± 6.15^{+}	32.00 ± 2.31*$^{+}$	30.67 ± 2.98*$^{+}$
180	50.67 ± 6.89	42.33 ± 4.53*$^{+}$	32.33 ± 4.38*$^{+}$	37.00 ± 5.00*$^{+}$
195	46.67 ± 6.79	49.67 ± 4.38	46.00 ± 4.62	46.67 ± 6.79
210	58.33 ± 6.05	58.33 ± 7.16	51.67 ± 4.68	52.33 ± 3.35
225	59.00 ± 7.64	61.00 ± 6.51	58.67 ± 4.27	56.00 ± 2.58
240	63.00 ± 9.07	65.67 ± 5.59	64.00 ± 3.06	59.00 ± 5.39

$^{+}$Significantly different from the basal values ($P < 0.05$). *Significantly different from treatment group 1 ($P < 0.05$). Treatment 1 (100 µg/kg medetomidine), treatment 2 (150 µg/kg medetomidine), treatment 3 (200 µg/kg medetomidine) and treatment 4 (250 µg/kg medetomidine) (n= 6).

Table 4. Mean (±SD) cloacal temperature (°C) following medetomidine administration in pigeons (*C. livia*).

Time (min)	Treatment groups			
	1	2	3	4
0	42.36 ± 0.34	42.48 ± 0.27	42.07 ± 0.26	41.96 ± 0.22
15	40.39 ± 0.20	39.94 ± 0.60	40.55 ± 0.77	39.48 ± 0.91
30	38.53 ± 0.68	37.84 ± 0.56	38.79 ± 0.80	37.76 ± 0.80^{+}
45	37.16 ± 0.82^{+}	36.96 ± 0.71^{+}	37.65 ± 1.30^{+}	36.55 ± 0.71^{+}
60	36.65 ± 0.13^{+}	36.39 ± 0.65^{+}	37.22 ± 1.53^{+}	35.55 ± 1.20^{+}
75	36.36 ± 0.66^{+}	35.63 ± 0.66^{+}	36.82 ± 1.53^{+}	34.55 ± 1.20^{+}
90	36.04 ± 0.81^{+}	35.69 ± 0.90^{+}	36.15 ± 1.50^{+}	33.91 ± 0.94^{+}
105	36.22 ± 0.78^{+}	36.26 ± 1.04^{+}	35.93 ± 1.19^{+}	33.96 ± 0.58*$^{+}$
120	36.55 ± 0.97^{+}	36.93 ± 1.02^{+}	36.09 ± 1.29^{+}	32.96 ± 0.58*$^{+}$
135	36.85 ± 1.06^{+}	37.41 ± 0.99^{+}	36.68 ± 1.36^{+}	33.05 ± 0.43*$^{+}$
150	37.51 ± 1.22^{+}	38.99 ± 1.00	38.30 ± 1.03	34.40 ± 1.16*$^{+}$
165	38.43 ± 1.05^{+}	38.99 ± 1.00	38.99 ± 0.97	35.43 ± 0.99*$^{+}$
180	39.32 ± 0.81	39.50 ± 0.81	38.84 ± 0.84	36.35 ± 1.00*$^{+}$
195	40.39 ± 0.97	40.74 ± 0.54	36.84 ± 0.84	36.35 ± 1.00*$^{+}$
210	41.69 ± 0.35	41.71 ± 0.36	41.01 ± 0.38	37.63 ± 1.16^{+}
225	42.10 ± 0.18	42.13 ± 0.14	41.89 ± 0.26	39.81 ± 0.72
240	42.46 ± 0.31	42.53 ± 0.19	42.18 ± 0.27	41.51 ± 0.31

$^{+}$Significantly different from the base line values ($P < 0.05$). *Significantly different from treatment group 1 ($P < 0.05$). Treatment 1 (100 µg/kg medetomidine), treatment 2 (150 µg/kg medetomidine), treatment 3 (200 µg/kg medetomidine) and treatment 4 (250 µg/kg medetomidine) (n= 6).

Table 5. Mean (±SD) erythrocyte count, total leukocyte and packed cell volume following medetomidine administration with time in domestic pigeons.

Hematological parameter	RBC count (Erythrocyte count × 10^6/ µ1)				WBC count (Total Leukocyte count × 10^3 µ1)				PCV (%) (Packed cell volume)			
Treatment group/time	1	2	3	4	1	2	3	4	1	2	3	4
0 min	3.13 ± 0.49	2.81 ± 0.69	3.23 ± 0.48	2.96 ± 0.41	23.70 ± 3.5	24.30 ± 4.34	25.52 ± 2.78	23.60 ± 2.21	51.33 ± 5.9	51.16 ± 5.27	55.00 ± 2.94	53.67 ± 5.73
10 min	4.59 ± 0.49+	3.92 ± 1.10+	3.58 ± .027+	3.89 ± 0.69+	23.37 ± 1.83	20.77 ± 3.28	22.60 ± 2.94	22.93 ± 0.68	53.0 ± 3.00	54.00 ± 5.00	54.00 ± 5.00	50.00 ± 1.00
60 min	3.73 ± 0.68	3.68 ± 0.93+	3.24 ± 0.53	4.96 ± 1.44+	23.02 ± 2.95	23.18 ± 1.76	21.05 ± 2.07	24.28 ± 0.21	56.00 ± 4.00	50.00 ± 4.00+	57.00 ± 4.00+	53.00 ± 4.00
150 min	3.89 ± 1.07	2.84 ± 0.49	4.19 ± 0.69+	4.12 ± 0.89+	23.68 ± 1.34	21.13 ± 1.89	22.17 ± 2.14	23.00 ± 1.00	54.00 ± 4.00	57.00 ± 4.00+	57.00 ± 4.00+	54.00 ± 3.00
24 h	2.45 ± 0.46	3.09 ± 0.59	3.82 ± 0.l6	3.35 ± 0.55+	21.47 ± 1.11	21.52 ± 0.72	21.80 ± 1.61	21.28 ± 1.69	50.00 ± 2.00	52.00 ± 2.00	50.00 ± 4.00	52.00 ± 1.00

$^{+}$Significantly different from the base line values ($P < 0.05$). *Significantly different from treatment group 1 ($P < 0.05$). Treatment 1 (100 µg/kg medetomidine), treatment 2 (150 µg/kg medetomidine), treatment 3 (200 µg/kg medetomidine) and treatment 4 (250 µg/kg medetomidine).

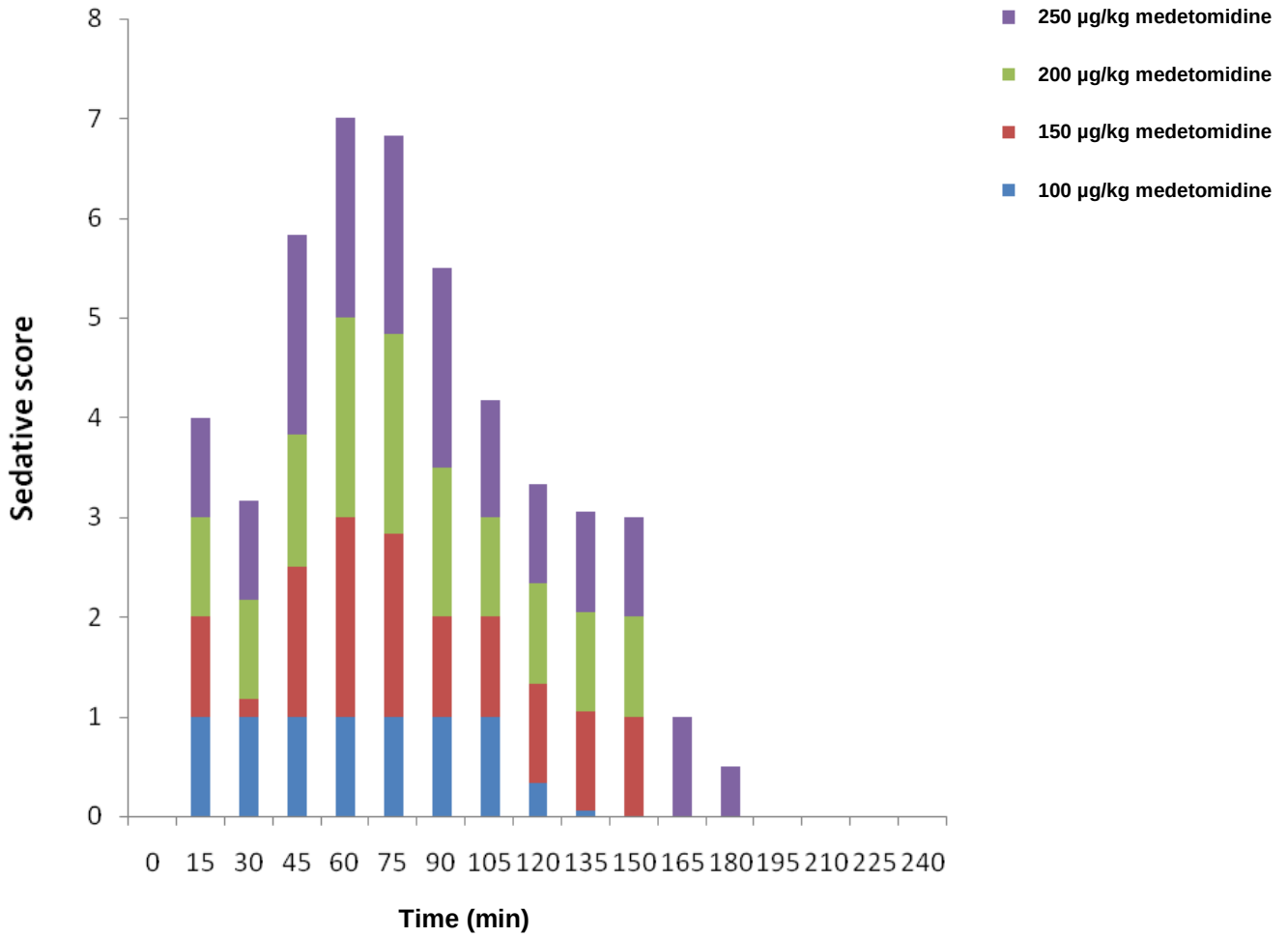

Figure 1. Sedative scores with time following medetomidine administration in pigeons (*C. livia*).

vasodilatation produced by alpha-2-agonists when given to healthy animals at moderate rate, as reported (Trim, 2002). The WBC does not show any significant change, which shows that the drug has no effect on the WBC values.

Conclusion

Since hematological parameters are good indices of livestock adaptability, a good indication of the haemogram, especially of the number of circulating erythrocytes, and having physiological parameters that are makers in the indication of safety in any surgical intervention, the analysis becomes relevant whenever medetomidine is to be used especially in pigeons.

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