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Research Article

Lumbosacral Epidural Analgesia with Ketamine Alone or in Combination with Xylazine in Dogs

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ABSTRACT

The study was performed on ten healthy dogs to evaluate the quality of analgesic effect on selected vital physiological parameters and complete haematological profiles. The dogs were randomly divided into ketamine alone (KA) and combination of ketamine + xylazine (KX) group, each group comprising five animals. Dogs in KA group were given fixed doses of ketamine at 10mgkg^{-1} through lumbosacral epidural space. Group KX were given ketamine at 10mgkg^{-1} in combination with Xylazine at 0.5mgkg^{-1} via the same route. There was complete analgesia caudal to the thoracic region in both the groups. The mean onset of analgesia in group KA was shorter (2.2±0.45) compared with group KX (2.8±0.84). Duration of analgesia in group KX was longer (60±12.23) compared with (50±7.07) in KA group. There was transient increase in heart and respiratory rates in all the groups with significant differences. There was decrease in RBC, Hb, PCV and RDW with significant differences. Transient decrease in total WBC, total granulocytes, lymphocytes and monocytes was also noticed with significant differences. There was also decrease in total platelets, platelets critical value, mean platelets volume and platelets dimension width with significant difference at certain timing intervals in all the groups. It was concluded that single lumbosacral epidural administration of ketamine (10mgkg^{-1}) alone or in combination with xylazine (0.5mgkg^{-1}) can produce analgesia caudal to thoracic region with minimal cardiopulmonary and haematological effects.

Key words: Analgesia, Dogs, Epidural, Ketamine, Lumbosacral, Xylazine

INTRODUCTION

In developing countries, local anaesthesia coupled with physical restraints is most commonly practiced anaesthetic technique in large animals practice. However, in small animals, intravenous general anaesthesia is the common anaesthetic protocol of choice. The cost of general anaesthesia, technical knowhow and the risk factors are some of the challenges that discourage the choice of the general anaesthesia as the sole anaesthetic protocol in some surgical procedures in canine. Epidural ketamine alone or in combination with xylazine may provide possible analgesia that can augments intravenous general anaesthetic protocol that lacks sufficient analgesia.

Epidural ketamine analgesic administration has been reported to be as an adjunct to general anaesthetic techniques in humans (Erol *et al*., 2014). Dose-dependent cardiopulmonary depression occurs with virtually all inhalant and general injectable anesthetic agents. As such epidural administrations of analgesics that reduce the requirement for general anaesthetic agents may also overcome cardiopulmonary depression limitation. Therefore, the epidural administration of analgesics before surgery will not only provides pre-emptive and intraoperative analgesia but can also provide excellent postoperative analgesia for considerable duration (Hendrix *et al*., 1996; Torske *et al*., 1998; Rauser *et al*., 2004).

The administration of pharmacological agents that has analgesic properties through the epidural or spinal routes has been in practice many years to provide effective localized anaesthesia and analgesia in both small and large animals patients (Otero and Campoy, 2013). Most recently reported pharmacological agents in use are local anaesthetic agents (Jahn *et al*., 2001; Turan *et al*., 2002; Bhannaria *et al*., 2005; Almeida *et al*., 2007; Lawal and Adetunji, 2009; Freire *et al*., 2010; Odette and Smith,

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2013), methylene blue solution in cat (Lee *et al*., 2004), morphine alone or in combination with local anaesthetic or other sedative agents (Pacharinsak *et al*., 2003; Otero, 2004; Kona-Boun *et al*., 2006; Stegall *et al*., 2009; Carregaro *et al*., 2013), α2 agonist and other potent sedatives were also reported to be used (Smith and Yu, 2001; Naganobu *et al*., 2004; Soares *et al*., 2004). However, there are limited studies using ketamine alone or in combination with other agents for epidural analgesia (Rao *et al*., 1999; Amarpal *et al*., 2003; Acosta *et al*., 2005; Hamilto *et al*., 2005; DeRossi *et al*., 2011), as such we make an attempt to study the effect of epidural administration of ketamine alone or in combination with xylazine. We hypothesized that epidural administration of ketamine alone or in combination with xylazine could produce effective intra or post operative analgesia with minimal cardiopulmonary effect. The aim of the study was to evaluate the effect of lumbosacral epidural administration of ketamine alone or in combination with xylazine in dogs, the specific objectives was, to determine and compare the duration and onset of analgesia, the effect of the analgesia on the vital parameters (rectal temperature, pulse rate, and respiratory rates) and the effect of the complete haematological indices.

MATERIALS AND METHODS

The study was approved by the faculty of veterinary medicine, Usmanu Danfodiyo University, Sokoto animal care committee. Ten (*n*=10) apparently healthy, intact Nigerian local dogs, of both sexes with body weight and age ranges 10-16kg and 12-20 months respectively were used for the investigation. The animals were conditioned for two weeks before commencement of the study. During the conditioning, they were clinically evaluated, fecal and blood samples were collected to determine the intestinal worm burden, blood parasite status and complete haematologic profile. During conditioning prophylactic broad spectrum antibiotic (Amoxicillin 100mg tablet at 5mgkg^{-1} [GlaxoSmithline, USA]) and anthelminthic (Drontal™ plus [paraziquantel 5mgkg^{-1}; pyrentel pamoate 5mgkg^{-1} and febentel 25mgkg^{-1}], Bayer, USA, were administered orally. The animals were randomly divide into two experimental groups (Ketamine alone [KA] and Ketamine + Xylazine [KX]), each group comprising five animals. Preliminary studies was conducted using graded doses of 2, 5, and 10mgkg-^{1} of ketamine hydrochloride and 0.25, 0.4 and 0.5mgkg-^{1} of xylazin injected through epidural space. Doses rate of 10mgkg-^{1} for ketamine and 0.5mkg-^{1} for xylazine were found to be effective.

Experimental design

Low dose of intravenous 1% acepromazine injection at 0.5mgkg^{-1} (Vedco, Inc., USA) was administered to the animals 15 minutes prior to epidural administration to provide mild sedation sufficiently to allowed experimental manipulation. The lumbosacral region was identified, and the hairs around the area were clipped. The area was scrub with Purit® (Chlorhexidine Gluconate, Saro LifeCare Limited, Lagos, Nigeria) followed by Methylated spirit (Binji Global Pharmaceutical Company, Sokoto, Nigeria). Twenty one gauges (0.8×40mm) hypodermic needle was used to deliver the anaesthetic agent into the epidural space (L7-S1). The needle was inserted just to the right of the lumbar spinous process on a line 1.5 cm behind the cranial edge of the transverse process. The needle was directed ventrally and medially at an angle of about 10–13° from the vertical for a distance of 5 cm at which point the needle entered the vertebral canal. The needle was passed further to penetrate the interarcuate ligament where a little resistance was felt. As it entered the epidural space the syringe was mounted on the hub and air was injected for loss of resistance. The air bubbles entered the syringe, which confirmed the correct placement of the needle in the epidural space. The injection was then made. The correctness of epidural injection was further ascertain as the agents were injected freely and easily entered the space and minimal resistance on injection and minimal pressure on the syringe plunger was needed according to procedure described by Jones, (2001); Hall *et al*., 2001; Otero and Campoy, (2013).

KA group received epidural administration of 5% ketamine hydrochoride (ketamine hydrochloride injection USP (Rotexmedica, Germany) at 10mgkg^{-1} diluted with a normal saline (1:3 ketamine normal saline ration). KX group received epidural administration of 5% ketamine hydrochoride at 10mgkg^{-1} in combination with 2% Xylazine injection (VMD, Belgium) at 0.5mgkg^{-1} also diluted with normal saline in the same ratio as in KA group.

Immediately after the administration, the onset time of analgesia was recorded; analgesia was determined by the lack of neurologic response at inter-digital space of both limbs, lack of anal tone, and hypodermic needle pricking of the skin caudal to the thoracic region. Duration of analgesia was also determined following immediate lack of neurologic response and hind limb paresis when dogs were allowed to walk until full responses were fully restored.

Physiological vital parameters involving; heart rate (HR), respiratory rate (RR) and rectal temperature (RT) were taken at baseline before the administration of the analgesic agents, and then subsequently at 10 minutes intervals till full neurologic responses were restored. The respiratory and heart rates were measured using stethoscope (Littmann® India), while rectal temperature was determined using digital clinical thermometer (united surgical diagnostic company, India). About 2mℓ of blood was collected for haematology through indwelling cephalic vein catheter; the blood samples were collected at baseline before the administration of the analgesic agents and at 10, 20, 30, 40, 50 and 60 minutes intervals after the onset of analgesia, the samples were preserved in 5mℓ EDTA bottle (Frank Healthcare Co. Ltd, China) and transported to the laboratory for complete haematological analysis. The samples were processed using full automated blood cell counter PCE-210 (ERMA INC. Tokyo, Japan).

Statistical analysis

Data obtained were recorded and presented as Means±SD. Student *t*-test was used to compare statistical difference between the two groups at 95% confidence interval using InStat3, Graph Pad statistical software package 2010.

RESULTS

Complete analgesia was observed in both KA and KX groups; the observable desensitization was detected caudal to the thoracic region down to the toes. Mild transient desensitization was observed cranial to thoracic areas in KX group only. Dogs in KX group were absolutely recumbent for 40 minutes after 5 minutes of epidural injection.

Onset and duration of analgesia

The onset of analgesia caudal to the thoracic areas was 2.2±0.45 minutes and 2.8±0.84 minutes in group KA and KX respectively, there was no significant difference between the two groups (P>0.05), although group KX had a higher onset time when compared with KA (Figure 1).

The duration of analgesia for KA and KX were 50±7.07 and 60±12.23 minutes respectively, there was no significant difference between the two groups (P>0.05). However, group KX had longer duration of analgesia when compared with group KA (Figure 2).

Physiologic parameters

There was increased trend of heart rates along the timing interval in KA group, while decreased heart rates were observed in KX group. There was significant difference between the groups at 20, 30, 40 and 50 minutes interval (Table 1). There was marked increase in respiratory rates at 10 and 50 minutes in KA group. Similarly, marked increases in respiratory rates were also observed in group KX at 20, 50, 60 and 70 minutes intervals. However, significant difference in respiratory rates between the groups was observed at 30 minutes interval only (P=0.01) (Table 1). There was no significant difference (P>0.05) in rectal temperature between the groups at different timing intervals. However, there was slight temperature increased in KA group with corresponding decreased in KX group (Table 1).

Erythrocyte indices

There was a significant difference (P<0.05) in red blood count (RBC) between the groups at 40, 50, 60 and 70 minutes, with KA group having higher values when compared with KX group (Table 2). Significant difference in haemoglobin at 40, 50 and 60 minutes interval between the groups were also observed, with KA group having higher haemoglobin values (Table 2). KA group had higher packed cells volume (PCV) throughout the timing interval, there was significant differences between the groups at 30, 40, 50, 60 and 70 minutes interval (Table 2). There were no significant differences in mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) between the groups at all the timing intervals. But the MCH values of KA group were a bit higher than KX group. The MCHC values of KX were slightly higher when compared with that of KA. There was significant difference of mean corpuscular volume (MCV) between the groups at 20, 30, 40, 60 and 70 minutes intervals with KA having higher values in comparison with KX. A significant difference in red blood cell dimension width (RDW) was also observed at 30, 50 and 70 minutes interval between the groups (Table 2).

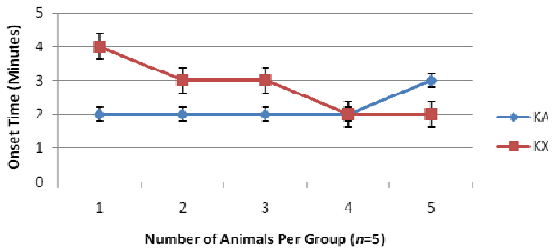

Fig. 1: Onset of analgesia (minutes) following epidural administration of ketamin alone (KA) and combination of ketamine xylazine (KX)

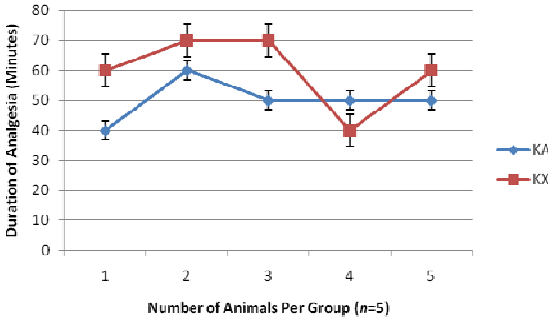

Fig. 2: Duration of analgesia (minutes) following epidural administration of ketamin alone (KA) and combination of ketamine xylazine (KX)

Leucocytic indices

There was significant difference in total white blood count (WBC) between the groups at 40 and 50 minutes intervals, with KA group having higher values. At 40 minute interval, there was significant difference in total granulocytes between the groups with KA group having higher value in comparison with KX. The lymphocytes value of KA group was higher when compared with KX group, there was significant difference between the group at 40 and 50 minutes intervals. A significant difference of monocytes was also recorded between the groups at 40, 50, 60 and 70 minutes intervals, the KA group had higher value than KX (Table 2).

Platelets indices

There was significant difference of total platelets value between the groups at 40 and 50 minutes interval, KA value was higher than KX when compared (Table 3). At 40 minute timing interval there was significant difference of platelets critical value with KA having higher value compared to KX. Significant difference in mean platelets volume between the groups at 40, 50 and 60 minute was also recorded; KA group had higher value compared with KX. At 30, 40 and 50 minutes interval, there was significant difference in platelets dimension width, with KA group having higher values when compared with KX (Table 3).

DISCUSSION

The results of the present study showed that, lumbosacral epidural administered ketamine in combination with xylazine (KX) in dog produced longer onset and duration of analgesia than ketamine alone (KA). The variation of onset of analgesia may be attributed to

Table 1: Heart rates (HR), respiratory rates (RR) and rectal temperature following epidural administration of ketamine alone (KA) and ketamine with xylazine (KX) (mean±sd)

	K			KX		
Time(mins)	HR(b/min)	RR(c/min)	RT(^{0}c)	PR(b/min)	RR(c/min)	RT(^{0}C)
Baseline	99.8±19.70	21.20±6.26	38.94±0.35	125.60±23.77	24.00±4.90	38.48±0.54
10	140.60±47.53	27.20±6.57	39.40±0.55	101.60±25.90	21.60±4.56	38.52±0.58
20	143.60±52.22^a	24.00±7.48	39.06±0.78	90.00±19.60^b	26.80±6.87	38.18±0.83
30	135.00±53.98^a	23.2±10.26	39.02±0.92	90.80±15.60^b	24.00±2.83	37.98±1.11
40	119.20±62.34^a	21.60±4.78^a	39.06±0.96	98.40±11.17^b	24.00±2.83^b	37.75±0.93
50	114.00±19.39^a	27.00±6.22	38.95±0.68	112.00±9.80^b	28.50±2.52	37.35±0.90
60	101.00±10.00	20.00±0.00	38.10±0.00	116.00±11.78	29.00±2.00	37.50±0.67
70	99.95±17.00	21.20±4.00	38.65±0.50	108.00±28.28	28.00±0.00	37.40±0.85

ab: Mean on the same row with different superscript are significantly different *(*P<0.05).

Table 2: Erythrocytes characteristic following epidural administration of ketamine (10mgkg^{-1}); and combination of ketamine (10mgkg^{-1}) + xylazine (0.5mgkg^{-1})

Parameters	Groups	Time Interval (mins)							
		0	10	20	30	40	50	60	70
RBC (X10^6/µℓ)	KA	6.39±0.91	5.79±0.72	5.28±0.51	5.54±0.75	6.03±0.77^a	6.34±0.50^a	6.05±0.20a	6.45±0.25^a
	KX	6.00±0.76	5.41±0.82	5.10±0.70	4.93±0.92	4.84±0.67^b	5.10±0.57^b	5.65±0.90^b	5.93±0.17^b
Haemoglobin	KA	16.30±2.72	14.82±2.28	13.00±1.56	13.68±2.10	15.24±1.5^a	16.05±1.05^a	15.30±1.02^a	15.20±1.00
(g/dℓ)	KX	15.04±2.65	13.42±2.63	12.46±2.36	12.06±2.78	11.90±2.2^b	12.90±2.00^b	14.1±0.81^b	14.60±0.90
PCV (%)	KA	41.18±5.25	37.58±3.95	36.2±5.40	36.02±4.6^a	39.36±4.4^a	40.52±2.90^a	40.00±3.00^a	41.50±3.5^a
	KX	37.58±4.14	34.62±5.84	31.9±3.60	30.84±5.7^b	30.30±5.0^b	31.98±4.28^b	36.23±2.36^b	36.05±1.6^b
MCH (pg)	KA	25.38±0.96	25.44±1.36	24.54±0.98	24.58±0.76	25.14±1.23	25.43±0.83	25.2±0.95	25.50±1.00
	KX	24.86±1.55	24.62±1.62	24.24±1.62	24.22±1.47	24.38±1.37	24.60±0.80	24.73±0.91	25.05±0.70
MCHC (g/dℓ)	KA	39.80±2.65	39.20±2.94	37.88±2.40	38.28±1.97	38.46±2.35	39.58±1.06	38.20±1.10	39.00±1.5^a
	KX	39.72±3.60	38.58±2.56	38.74±3.43	38.78±2.26	39.12±2.33	39.50±3.05	38.63±2.18	41.30±0.4^b
MCV (fℓ)	KA	64.58±1.23	64.98±0.83	64.90±1.18	64.28±0.93	65.36±0.71	64.10±0.67	66.10±0.90	65.50±0.95
	KX	62.62±0.66	63.92±1.76	62.70±0.96	62.52±1.33	62.48±1.63	62.75±2.62	64.13±1.81	61.20±0.98
RDW (%)	KA	16.60±0.34	16.62±0.20	16.52±0.08	16.40±0.2^a	16.74±0.10	16.65±0.18^a	16.90±0.50^a	16.60±0.5^a
	KX	16.42±0.38	16.22±0.39	16.34±0.35	15.94±0.2^b	16.10±0.22	15.70±0.35^b	16.13±0.39^b	15.70±0.2^b

ab: Mean on the same row with different superscript are significantly different *(*P<0.05).

Table 3: Leucocytic characteristics following epidural administration of ketamine (10mgkg^{-1}) and Combination of Ketamine (10mgkg^{-1}) + xylazine (0.5mgkg^{-1})

Parameters	Groups	Time Interval (mins)							
		0	10	20	30	40	50	60	70
Total WBC (X10^3/µℓ	K	16.14±4.35	14.00±3.26	12.02±3.73	11.08±2.04	15.42±3.8^a	16.95±2.95^a	12.60±3.00	14.50±3.50
	KX	14.16±3.60	13.20±3.71	13.10±5.08	11.38±4.57	11.18±2.9^b	10.98±5.37^b	13.37±3.09	12.85±2.19
Total Granulocytes	K	6.39±0.91	5.79±0.72	5.28±0.51	5.54±0.75	6.03±0.77^a	6.34±0.50	6.05±0.55	6.30±0.60
(X10^3/µℓ	KX	6.00±0.76	5.41±0.82	5.10±0.70	4.93±0.92	4.84±0.67^b	5.10±0.57	5.65±0.90	5.93±0.17
Lymphocytes	K	16.30±2.72	14.82±2.28	13.00±1.56	13.68±2.10	15.24±1.5^a	16.05±1.05^a	15.30±1.45	16.30.2.00
(X10^3/µℓ	KX	15.04±2.65	13.42±2.63	12.46±2.36	12.06±2.78	11.90±2.2^b	12.90±2.00^b	14.10±0.81	14.60±2.50
Monocytes (X10^3/µℓ	K	41.18±5.25	37.58±3.95	36.20±5.40	36.02±4.62	39.36±4.4^a	40.52±2.99^a	40.00±2.3^a	41.17±3.0^a
	KX	37.58±4.14	34.62±5.84	31.90±3.60	30.84±5.68	30.03±5.0^b	31.98±4.28^b	36.23±2.4^b	36.05±2.6^b

ab: Mean on the same row with different superscript are significantly different *(*P<0.05)

Table 4: Platelets Characteristic following epidural administration of ketamine (10mgkg^{-1}); and combination of xylazine ketamine (10mgkg^{-1}) + (0.5mgkg^{-1})

Parameters.	Groups	Time Interval (mins)							
		0	10	20	30	40	50	60	70
Platelets (X10^3/µℓ	K	16.14±4.35	14.00±3.26	12.02±3.73	11.08±2.04	15.42±3.8^a	16.95±2.95^a	12.60±2.35	15.20±3.00
	KX	14.16±3.60	13.20±3.71	13.10±5.08	11.38±4.57	11.18±2.9^b	10.98±5.37^b	13.37±3.09	12.85±2.19
Platelets Crit.	K	6.39±0.91	5.79±0.72	5.28±0.51	5.54±0.75	6.03±0.77^a	6.34±0.50	6.05±0.45	6.25±0.55
Value (%)	KX	6.00±0.76	5.41±0.82	5.10±0.70	4.93±0.92	4.84±0.67^b	5.10±0.57	5.65±3.09	5.93±0.17
Mean platelets	K	16.30±2.72	14.82±2.28	13.00±1.56	13.68±2.1	15.24±1.5^a	16.05±1.05^a	15.30±1.5^a	16.00±1.35
Volume (fℓ)	KX	15.04±2.65	13.42±2.63	12.46±2.36	12.06±2.78	11.90±2.2^b	12.90±2.00^b	14.10±0.8^b	14.60±2.00
Platelets Dimension	K	41.18±5.25	37.58±3.95	36.20±5.40	36.02±4.6^a	39.36±4.4^a	40.52±2.99^a	40.00±4.00	41.00±4.50
Width (fℓ)	KX	37.58±4.14	34.62±5.84	31.90±3.60	30.84±5.7^a	30.30±5.0^b	31.98±4.28^b	36.23±2.36	36.05±2.63

ab: Mean on the same row with different superscript are significantly different *(*P<0.05).

lipid solubility and physiochemical properties such as Pka and pH of the drugs combination in relation to the density of the receptor population and the cell type in which the receptors are located. The variation could also be as a result of protein binding capacity of the combination (Jones, 2001). While Torske and Dyson, (2002) suggested that the onsets of epidural analgesia depend on the penetration of the agent into the nerve trunk and the peak concentration of the agent varies inversely with the size of the nerve. Contrary to the finding of Singh *et al*. 2005); Azari *et al*. (2014) that reported short onset of epidural analgesia in a separate studies involving buffalo calves

using lignocaine + xylazine and ketamine + lignocaine combination in dromedary camel.

The longer duration of analgesic activity (60±12.23) and recumbency noticed in KX group following single epidural administration may be due to the sedative effect of xylazine. The longer duration and greater deep of analgesia also suggested good additive interaction between ketamine and xylazine, the finding is in agreement with that of Singh *et al*. (2005) that reported longer duration of activity using lignocaine incombination with xylazine in buffalo calves. Sarrafzadeh-Rezaei *et al*. (2007) also reported longer duration of activity in ketamine + xylazine combination in donkey. Our finding is also in agreement with that of Azari *et al*. (2014) in which combination of ketamine and lignocaine produces longer duration of analgesia in caudal epidural analgesia using dromedary camel.

The transient increased in heart rate at 10 and 20 timing interval in KA group could be as a result mild cardiac depression, as parentral administration of ketamine is associated with tachycardia due to its ability to blocks voltage-dependent calcium channels and sodium channels, attenuating hyperalgesia; it was also reported to alters cholinergic neurotransmission, which is implicated in pain mechanisms; and it inhibits the reuptake of serotonin and norepinephrine, which are involved in descending antinociceptive pathways (Hall, *et al*., 2001; Mion and Villevielle, 2013). While the decreased in heart rate in KX group may be attributed to rapid systemic absorption of xylazine that might have overwhelm ketamine activity, it has been reported that xylazine cause significant decrease in heart rate and cardiac output in dogs, while blood pressure and peripheral vascular resistance initially increase (Vesal *et al*., 2011; Rostami and Vesal, 2012). The transient increase of the respiratory rates in the KX group could also be attributed to xylazine effect following rapid systemic absorption as described earlier, this finding is consistent with that of Afshar *et al*. (2005) that also reported an increased in respiratory rate following systemic administration of ketamine xylazine in goat.

The transient decreased in red blood count (RBC), haemoglobin (Hb) and packed cells volume (PCV) in both groups could be as a result rapid systemic absorption of both agents, which lead to the acute shifting of fluid from extra-vascular compartment to intravascular compartment to maintain normal cardiac output in animals, as reported by Mion and Villevieille, (2013) that epidurally administered ketamine rapidly goes to systemic circulation. Kilic, (2008) suggested that poling of circulating blood cells in the spleen and other reservoirs secondary to decreased sympathetic activity to be the reason for decrease in PCV, Hb and RBC during state anaesthesia and sedation. Ismail *et al*. (2010) has reported decreased in red blood count and haemoglobin but increased in packed cells volume in xylazine, ketamine and diazepam anaesthesia in goat and sheep. Umar and Wakil (2013) also reported significant decrease in RBC, Hb and PCV in ketamine, medetomidine anaesthesia in goat.

The significant decreased trend of total white blood count (WBC), total granulocyte, lymphocytes and monocytes observed for short time in both groups could also be attributed to the acute stress following epidural administration of the ketamine and xylazine. Carrol *et al*. (1997) reported that total and differential leukocyte counts might be altered by stress events, and corticosteroid-induced changes. This might indicate that the doses of alpha-2 adrenergic agonists (xylazine) and ketamine used in the present study were not sufficient to control stress completely. The concentration of major stress biomarker (cortisol) was not determined in the blood of the dogs in this study. Umar and Wakil (2013) reported a decrease in total WBC with corresponding increase in leukocytic differentials in a study involving goats using ketamine and medetomidine. While Ismail *et al*. (2010) reported that both total WBC and the differential counts were increased in a study involving small ruminant using ketamine, xylazine and diazepam.

The transient decreased in platelets count, platelets critical value, mean platelets volume and platelets dimension width is a suggestive acute direct myelo-suppression on megakaryocytes. It could also be as a result of splenic sequestration due to poling of circulating blood cells. Our finding is consistent with that of Lemke *et al*. (2002) and Aydilek *et al*. (2007), in which decreased in platelet count was observed in two different anaesthesia studies involving dogs and horse.

Conclusions

The single lumbosacral epidural administration of 5% ketamine ($10mgkg^{-1}$) alone or in combination with 2% xylazine ($0.5mgkg^{-1}$) can produce analgesia caudal to thoracic region in less than 3 minutes; either combination can be use to produce analgesia for maximum period of 50-60 minutes duration. Epidural ketamine alone or in combination with xylazine produces very mild cardiopulmonary and haematological effects, therefore can be safe to use in healthy dog without much physiological compromise. There is a need for epidural catheterization for continuous infusion to maintain analgesia in procedures lasting beyond 50-60 minutes.

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