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Comparative evaluation of haematological and biochemical changes due to romifidine-ketamine-isoflurane and romifidine-propofol-isoflurane combinations for various surgeries in goats

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Abstract
The study was carried out in 12 clinical cases of goats presented for various surgical procedures and were randomly divided into two groups consisting of six goats in each group. The goats of both the groups were premedicated with romifidine hydrochloride (50 µg/kg, IV). After ten minutes the animals of group I and II were induced with ketamine (6 mg/kg, IV) and propofol (6 mg/kg IV) respectively then anaesthesia maintained with isoflurane (1-2%) in both the groups. Haemoglobin and total erythrocyte count decreased non-significantly, whereas, packed cell volume and total leukocyte count decreased significantly at maximum depth of anaesthesia in both the groups. All the haemato-biochemical changes were within physiological limits. The preanesthetic and the general anaesthetic combinations followed in both the groups provided satisfactory surgical plane of anaesthesia and were ideal and safe to perform major surgeries in goats without any complications.

Keywords: Romifidine, ketamine, isoflurane, propofol, goats

Introduction
Use of different anaesthetic drugs (local or general) has mainly been responsible for the advancement of veterinary surgery. In ruminants the use general anaesthesia is usually avoided due to complications like regurgitation, tympany, internal suffocation and hypersalivation. Most of the surgical interventions are carried out under either local analgesia or regional blocks. Caprine are delicate and quite sensitive to pain among the ruminants. Even the minor surgical procedure requires desensitization of the area involved. Preanaesthetics are used to facilitate smooth induction and recovery *viz*., tranquilizers, sedatives and narcotics have been used for premedication. The use of romifidine is attributed only to its sedative effect. These agents produce a dose-dependent sedative effect. Ketamine produces profound analgesia without muscle relaxation that is characterized by catatonic and amnesia with or without actual loss of consciousness. The surgical anaesthesia and muscle relaxation is poor, however it might be improved by sedatives such as diazepam, xylazine and detomidine (Durgun *et al.*, 1990 and Afshar *et al*., 2005) [4, 32]. The most frequently used anaesthetic combinations in goats are ketamine-xylazine, ketamine-medetomidine and tiletamine -zolazepam (Lumb and Jones, 1996). For anaesthesia in the goat, medetomidine (Mohammad *et al.*, 1989) [33] or a combination of drugs has been used (Pawde *et al.*, 1996; Afshar *et al.*, 2005 and Mahmood and Mohammad, 2008) [34, 32, 19]. Propofol has rapid onset and short duration of action, with rapid recoveries make the drug potentially useful in ruminants, in which these features are particularly desirable. Reports on the use of propofol for induction and maintenance of anaesthesia have indicated its suitability in goats (Nolan and Reid, 1991, Reid *et al.*, 1993) [18, 35]. Isoflurane is a commonly used inhalant anaesthetic agent, which has short induction and recovery times because of its low lipid solubility coefficient (Antognini and Eisele, 1993) [36].

Materials and Methods
Sources of research animals
The present clinical study was carried out in 12 clinical cases of goats of either sex presented for various surgical procedures at Veterinary College, Bidar.

All the goats were randomly Divided into two groups consisting of six goats in each group.

Preanesthetic preparation of animals
All the animals were kept off feed for 12 to 24 hours depending on age of animal and water was withheld for 6-12 hours prior to anaesthesia and surgery. Adequate pre-operative fluid therapy was given to all the animals. The clinical status of the animals was assessed by recording heart rate, respiratory rate and rectal temperature and by estimating haematological and biochemical parameters prior to anaesthesia.

Procedure of the study
Sedation and induction
The goats in Group-I were premedicated with romifidine hydrochloride at the dose rate of 50 µg/kg body weight intravenously. After ten minutes of romifidine administration, the animals were restrained in lateral recumbency and anaesthesia was induced by administering ketamine at the dose rate of 6 mg/kg body weight intravenously. The animals were maintained under isoflurane anaesthesia. In the Group-II, animals were administered with romifidine hydrochloride at the dose rate of 50 µg/kg body weight intravenously. After ten minutes, the animals were restrained in lateral recumbency and anaesthesia was induced by administering propofol intravenously at the dose rate of 6 mg/kg body weight. The animals were maintained under isoflurane anaesthesia.

Maintenance of anaesthesia
The anaesthetic machine was used to maintain anaesthesia with isoflurane. Semi closed system was used for all animals. The 100% oxygen was given with flow rate set at 2 liters per minute for the first two minutes to increase the fraction of inspired oxygen concentration. The fresh gas flow rate was then reduced to one to two liters per minute based on the size of the animal. Initially isoflurane was given with vaporizer setting at 3%, until downward rotation of eyeball. Later vaporizer setting was reduced to 1-2%. The vaporizer setting was altered during anaesthesia, as and when required to maintain uniform surgical plane of anaesthesia. After completion of surgery, isoflurane vaporizer was closed by setting the vaporizer at 0%. Oxygen (100%) was given until the restoration of swallowing reflex. After reappearance of swallowing reflex, anaesthetic machine was disconnected from endotracheal tube and endotracheal tube was removed after deflating the cuff.

Evaluation
To evaluate the efficacy of anaesthetic protocol, the following parameters were recorded before, during and after anaesthesia.

Haematological observations
Blood samples were collected before premedication (0 minute), 60 minutes after induction of general anaesthesia and 120 minutes after anaesthesia to estimate the following haematological parameters.

Haemoglobin (g/dL)
Haemoglobin was estimated by Sahli's Haemoglobin ometer as per the standard method recommended by Schalm *et al.* (1975) [37]. The values were expressed in g/dL.

Packed Cell Volume (%)
Packed cell volume was estimated by micro haematocrit as described by Benjamin (1985) and the values were expressed in percentage.

Total Erythrocyte Count (×106/µL)
Total erythrocyte count was estimated as per the procedure described by Schalm *et al.* (1975) [37] using Neubauer's slide and the values were expressed in million cells per microlitre of blood.

Total Leukocyte Count (×103/µL)
Total leukocyte count was estimated as per the procedure described by Jain (2000) [38] and the values were expressed as thousand cells per microlitre of blood.

Differential Leukocyte Count (%)
Differential leukocyte count was estimated by staining the blood smear with Giemsa stain and 100 leukocytes were counted by using Battlement method described by Jain (2000) [38]. The differential leukocyte count was expressed in percentage.

Biochemical observations
Blood samples were collected before premedication (0 minute), 60 minutes after induction of general anaesthesia and 24 hours after anaesthesia. Serum was separated for the estimation of following biochemical parameters.

Serum aspartate transaminase (IU/L)
Serum aspartate transaminase level was estimated by auto analyzer. The values were expressed as IU/L.

Serum alanine transaminase (IU/L)
Serum glucose level was estimated by auto analyser. The values were expressed as mg/dL.

Serum Creatinine (mg/dL)
Serum creatinine level was estimated by auto analyser. The values were expressed in mg/dL.

Serum Urea Nitrogen (mg/dL)
Serum urea nitrogen was estimated by auto analyser. The values were expressed in mg/dL.

Statistical analysis
The mean and standard error of all parameters were computed as per Snedecor and Cochran (1994) [27]. The variations in clinical, physiological, haemodynamic, haematological and biochemical parameters were compared at different time intervals within the group and between the groups and were analysed using student't' test as described by Snedecor and Cochran (1994) [27].

Table 1: Design of the technical programme of the clinical study

Sl. No.	Groups	Number of animals	Surgeries performed	Anaesthetic protocol
1	Group- I	6	Surgical repair of tibial fracture using IILN	Induction: Romifidine[1] (50 µg/kg, IV) Ketamine[2] (6 mg/kg, IV) Maintenance: Isoflurane[3] (1-2%)
			Surgical repair of tibial fracture using Steinmann pinning	
			Oesophageal obstruction-Oesophagotomy	
			Application of fiberglass for fracture of left metatarsal bone.	
			Plating for fracture of right radius and ulna bones	
			k-nailing for left femur bone fracture	
2	Group – II	6	Surgical repair for left teat injury(ablation)	Induction: Romifidine[1] (50 µg/kg, IV) Propofol[4] (6 mg/kg, IV) Maintenance: Isoflurane[3] (1-2%)
			Application of fiberglass for fracture of left metatarsal bone.	
			Plating for fracture of left tibial bone	
			Plating for fracture of left femur bone	
			Castration by open method	
			Application of fiberglass for fracture of left radius and ulna bone	

Results

Haemoglobin (g/dL)

In goats of both groups I and II, non-significant reduction in haemoglobin level was observed at all intervals of anaesthesia. However, all the values were within the normal physiological limits. No significant difference was observed between the groups with respect to haemoglobin levels and fluctuated within the normal physiological limits at all intervals of study.

Packed Cell Volume (%)

Packed cell volume was significantly ($p \leq 0.01$) decreased at 60 minutes after administration of general anaesthesia in goats of both the groups. Comparison between the groups revealed no significant difference with respect to packed cell volume at all intervals of study.

Total Erythrocyte Count (×106/µL)

No significant changes were observed with respect to total erythrocyte count and fluctuated within normal physiological limits within and between the groups at all intervals of study.

Total Leukocyte Count (×103/µL)

In goats of both group I and II, significant ($p \leq 0.05$) decrease in total leukocyte count was seen at 60 minutes after induction of general anaesthesia. Comparison between the groups revealed that total leukocyte count was no significantly lower at 60 minutes after propofol-isoflurane general anaesthesia than with ketamine-isoflurane general anaesthesia in goats.

Table 1: Mean±S.E of haematological parameters at different intervals in goats of groups I and II

Sl. No.	Parameter	Time Intervals		Group I	Group II
1	Haemoglobin (g/dL)	Before premedication	0 min	10.74±0.54	10.30±0.41
		After premedication	10 min	10.61±0.55	10.15±0.46
		After ketamine or propofol - isoflurane	60 min	10.54±0.55	10.01±0.50
			120 min	10.62±0.52	9.85±0.47
2	Packed Cell Volume (%)	Before premedication	0 min	24.71±1.35	22.70±0.61
		After premedication	10 min	21.13±0.90	20.81±0.53
		After ketamine or propofol - isoflurane	60 min	22.63±1.42*	20.35±0.22**
			120 min	23.86±1.21	23.20±0.95
3	Total Erythrocyte Count (×106/µL)	Before premedication	0 min	14.81±0.87	14.92±0.34
		After premedication	10 min	14.41±0.81	14.80±0.36
		After ketamine or propofol - isoflurane	60 min	14.34±0.82	14.37±0.23
			120 min	14.21±0.83	14.01±0.33
4	Total Leukocyte Count (103/µL)	Before premedication	0 min	9.68±0.74	10.92±0.88
		After premedication	10 min	8.88±0.66,	10.83±0.88
		After ketamine or propofol - isoflurane	60 min	7.54±0.56*	8.48±0.51*
			120 min	8.56±0.60	9.83±0.77

Means bearing superscript* differ significantly ($p \leq 0.05$) from interval 'before' within the group Means bearing superscript a, b differ significantly ($p \leq 0.05$) between the groups at corresponding intervals

Differential Leukocyte Count (%)

Neutrophils (%)

In goats of both groups I and II, significant ($p \leq 0.05$) increase in the neutrophils count was seen at 60 minutes after induction of general anaesthesia. Comparison between the groups revealed significant ($p \leq 0.05$) increase in neutrophils at 60 minutes in goats with romifidine-propofol-isoflurane anaesthesia than that of romifidine -ketamine -isoflurane anaesthesia.

Lymphocytes (%)

No significant reduction in the lymphocyte count was observed at 60 minutes after ketamine-isoflurane anaesthesia in goats of group I. However, the values were within normal physiological limits. Comparison between the groups revealed no significant difference at all intervals of study.

Monocytes (%)

Monocytes count fluctuated within normal physiological limits at all intervals of study and no significant difference was observed in both the groups and also between the groups.

Eosinophils (%)

The eosinophils count fluctuated within normal physiological limits and no significant Difference was observed within the groups and between the groups at all intervals of study.

Basophils (%)

Since the basophils number was very less and the values was within normal range, therefore its values were not tabulated.

Table 2: Mean±S.E of differential leukocyte count at different intervals in goats of groups I and II

Sl. No.	Parameter	Time Intervals		Group I	Group II
1	Neutrophils (%)	Before premedication	0 min	41.33±1.83	40.00±0.85
		After premedication	10 min	41.50±1.68	40.33±1.14
		After ketamine or propofol - isoflurane	60 min	46.67±1.49*[a]	42.16±0.61*[b]
			120 min	41.00±1.21	42.16±0.87
2	Lymphocytes (%)	Before premedication	0 min	54.50±1.82	56.66±1.20
		After premedication	10 min	53.50±1.60	49.66±6.98
		After ketamine or propofol - isoflurane	60 min	49.16±1.74	53.66±1.72
			120 min	50.33±1.83	55.00±1.61
3	Monocytes (%)	Before premedication	0 min	2.16±0.30	1.15±0.46
		After premedication	10 min	1.34±0.34	1.16±0.47
		After ketamine or propofol - isoflurane	60 min	1.50±0.22	1.00±0.25
			120 min	1.34±0.42	0.84±0.30
4	Eosinophils (%)	Before premedication	0 min	1.34±0.33	1.50±0.42
		After premedication	10 min	1.00±0.25	1.00±0.36
		After ketamine or propofol - isoflurane	60 min	1.16±0.30	1.33±0.33
			120 min	0.83±0.30	1.00±0.25

Means bearing superscript* differ significantly ($p \leq 0.05$) from interval 'before' within the group Means bearing superscript** differ significantly ($p \leq 0.01$) from interval 'before' within the group Basophil count in both the groups at all the intervals was '0

Biochemical observations

The biochemical observations *viz.*, aspartate transaminase, alanine transaminase serum creatinine and serum urea nitrogen were estimated in goats of both the groups before premedication (0 minute), at 10 minutes after premedication with romifidine and at 60, 120 minutes after ketamine (Group I) or propofol (Group II)-isoflurane anaesthesia.

Serum Aspartate Transaminase (IU/L)

The values of serum aspartate transaminase (AST) fluctuated within normal physiological limits and no significant difference was observed within the groups and between the groups at all intervals of study.

Serum alanine amino transferase (IU/L)

The values of serum alanine amino transaminase (ALT) fluctuated within normal physiological limits and no significant difference was observed within the groups and between the groups at all intervals of study.

Serum Creatinine (mg/dL)

In goats of both groups I and II, no significant increase in the serum creatinine level at 60 minutes was observed. Comparison between the groups revealed no significant difference with respect to serum creatinine at all intervals of study and all the values were within normal physiological limits in both the groups.

Serum Urea Nitrogen (mg/dL)

In goats of both groups I and II, non-significant increase in the serum urea nitrogen level at 60 and 120 minutes after ketamine (Group I) and propofol (Group II)-isoflurane anaesthesia was observed. Serum urea nitrogen values fluctuated within normal physiological limits at all intervals of study in both the groups. No significant difference was observed between the groups with respect to serum urea nitrogen.

Table 3: Mean±S.E of biochemical parameters at different intervals in goats of groups I and II

Sl. No.	Parameter	Time Intervals		Group I	Group II
1	Serum Aspartate Transaminase (IU/L)	Before premedication	0 min	86.81±2.24	87.77±2.03
		After premedication	10 min	86.30±2.46	86.80±2.34
		After ketamine or propofol - isoflurane	60 min	87.16±2.40	86.08±2.25
			120 min	86.63±2.28	86.53±2.32
2	Serum alanine amino transferase (mg/dL)	Before premedication	0 min	35.55±1.92	35.90±2.26
		After premedication	10 min	34.98±1.83	35.30±2.13
		After ketamine or propofol - isoflurane	60 min	34.70±1.77	35.21±2.22
			120 min	34.85±1.78	34.75±1.67
3	Serum Creatinine (mg/dL)	Before premedication	0 min	0.88±0.11	0.88±0.11
		After premedication	10 min	0.81±0.09	0.83±0.10
		After ketamine or propofol - isoflurane	60 min	0.92±0.14	0.92±0.08
			120 min	0.92±0.13	0.80±0.08
4	Serum Urea Nitrogen (mg/dL)	Before premedication	0 min	29.56±1.38	30.36±1.52
		After premedication	10 min	28.60±1.49	29.81±1.55
		After ketamine or propofol - isoflurane	60 min	28.20±1.48	30.81±1.53
			120 min	28.40±1.62	30.83±1.43

All values fluctuated within normal physiological limits

Discussion

Haemoglobin

In goats of both groups I and II, non -significant reduction in haemoglobin level was observed at all intervals of anaesthesia. However, all the values were within the normal physiological limits. No significant difference was observed between the groups with respect to haemoglobin levels and fluctuated within the normal physiological limits at all Intervals of study. Similar observations made by Saxena *et al.* (2001) [24] where Hb% altered non-significantly in goats premedicated with romifidine. Kumar *et al.* (1985) [13] reported significant decrease in haemoglobin in goats after induction of ketamine with and without diazepam and triflupromazine. Genccelep *et al.* (2004) [6] observed decrease in haemoglobin value during isoflurane anaesthesia in sheep. Karan *et al.* (2014) [41] reported a non-significant decrease in Hb was observed at 5 min of propofol administration and at recovery in comparison to base value in buffalo calves.

Khattri *et al.* (2013) [10] observed significant decrease in haemoglobin from 15 to 90 min dexmedetomidine-butorphanol-propofol anaesthesia in buffaloes. On contrary, Kumar *et al.* (2014) [12] observed no significant change in haemoglobin concentration after dexmedetomidine-ketamine anaesthesia in goats. Sharma *et al.* (2014) [25] reported that haemoglobin remained unchanged in butorphanol-dexmedetomidine -ketamine-halothane anaesthesia in dogs.

The decrease in haemoglobin during anaesthesia might be caused by the shifting of fluid from the extravascular compartment in order to maintain normal cardiac output (Wagner *et al.*, 1991) [31]. Pooling of circulating blood cells in the spleen and other reservoirs secondary to decreased sympathetic activity could also be the reason for a decrease in haemoglobin (Kilic, 2004) [4] Udegbunam *et al.* (2009) [2] observed decrease in haemoglobin in splenectomised dogs after ketamine administration and attributed to sequestration of red blood cells in non-splenic sites.

Packed Cell Volume

Packed cell volume was significantly ($p \leq 0.01$) decreased at 60 minutes after administration of general anaesthesia in goats of both the groups. Comparison between the groups revealed no significant difference with respect to packed cell volume at all intervals of study. Similar finding was observed after dexmedetomidine administration in buffaloes (Khattri *et al.*, 2013) [1]. On the contrary, no significant change in packed cell volume was seen after dexmedetomidine-ketamine anaesthesia in goats (Kumar *et al.*, 2014) [12]. Kumar *et al.* (1985) reported significant decrease in PCV in goats after induction of ketamine with and without diazepam and triflupromazine. Peshin (2010) [23] and Kumar *et al.* (2011) [44] also observed non-significant variations in Hb and PCV in buffalo calves after propofol administration.

Umar and Wakil (2013) [3] observed significant decrease in PCV after medetomidine- ketamine anaesthesia in goats. Genccelep *et al.* (2004) [6] reported that packed cell volume decreased during isoflurane anaesthesia in sheep. Hikasa *et al.* (2000) [40] reported decrease in packed cell volume in sheep under isoflurane anaesthesia and up to 3 days post anaesthesia. The decrease in packed cell volume may be probably due to the stress caused by the sedative drugs, decreased heart rate and blood pressure and haemodilution by infiltration of interstitial fluids during anaesthesia. Pooling of circulatory blood cells in the spleen or other reservoirs secondary to decreased sympathetic activity may explain the decrease in PCV recorded in the present study (Wagner *et al.*, 1991) [31]. The decrease in PCV during the period of anaesthesia or sedation may be due to shifting of fluid from extravascular compartment to intravascular compartment in order to maintain normal cardiac output in animals (Kinjavdekar *et al.*, 1999) [9].

Total Erythrocyte Count

Total erythrocyte count did not vary significantly both within the groups and between the groups at all the intervals of study. Similar findings were observed after dexmedetomidine-ketamine anaesthesia (Kumar *et al.*, 2014) [12] and medetomidine- ketamine anaesthesia (Umar and Wakil, 2013) [3] in goats. However, Saxena *et al.* (2001) [24] reported reduction in TEC significantly ($p<0.05$) at 1 hr in group B (romifidine +ketamine) while in group A (romifidine + thiopental) the values remained non- significantly lower from base line up to 72 hr. Chandrashekarappa *et al.* (2009) [3] observed that non-significant decrease in total erythrocyte count, packed cell volume, and haemoglobin under atropine-propofol-pentazocine combination in dogs. However, Monsang (2011) [39] observed decrease in total erythrocyte count after injecting dexmedetomidine in sheep. Significant decrease in erythrocyte count was observed after isoflurane anaesthesia in sheep and goat (Hikasa *et al.*, 2000) [40].

Total Leukocyte Count

In goats of both group I and II, significant ($p \leq 0.05$) decrease in total leukocyte count was seen at 60 minutes after induction of general anaesthesia. Comparison between the groups revealed that total leukocyte count was non-significantly lower at 60 minutes after propofol-isoflurane general anaesthesia than with ketamine -isoflurane general anaesthesia in goats. However, Saxena *et al.* (2001) [24] reported TLC levels remained fluctuating close to base values during the observation period in goats premedicated with romifidine and induced with ketamine and thiopental. Basavaraj (2015) [2] reported total leucocyte count decreased significantly between 30 and 60 minutes post induction with propofol when compared to pre-anaesthetic level, however it again increased 24 hours post anaesthesia. Decrease in the total leucocyte count was observed at maximum depth of anaesthesia in both groups, and subsequently it increased to base value by 24 hours post- anaesthesia. Similar findings have been reported after midazolam-ketamine anaesthesia in horses (Malik and Singh, 2007) [43], in goat (Abu-Ahmed, 2013) [50] and in calves (Nuh, 2008) [51], and after fentanyl-medetomidine-thiopentone-isoflurane anaesthesia in buffaloes (Singh *et al.*, 2013) [10]. Umar and Wakil (2013) [3] observed no significant change in leukocyte count after medetomidine-ketamine anaesthesia in goats. Kumar *et al.* (2001) [45] observed significant decrease in total leukocyte count from 5 to 45 minutes during haloperidol-ketamine anaesthesia in dogs. Steffey *et al.* (1977) [46] reported that leukocyte count increased significantly 24 hours after isoflurane anaesthesia in foals. In the present study inter- compartmental fluid shift or splenic pooling of cells might have caused decrease in total leucocyte count.

Differential Leukocyte Count

In goats of both groups I and II, significant ($p \leq 0.05$) increase in the neutrophils count was seen at 60 minutes after induction of general anaesthesia. Comparison between the groups revealed significant ($p \leq 0.05$) increase in neutrophils at

60 minutes in goats with romifidine-propofol-isoflurane anaesthesia than that of romifidine-ketamine- isoflurane anaesthesia. Non-significant reduction in the lymphocyte count was observed at 60 minutes after ketamine-isoflurane anaesthesia in goats of group I. Similar findings recorded by Nikhit (2017) [20] who reported a significant increase in neutrophils with a subsequent significant decrease in lymphocytes was observed at 60 minutes and at 24 hours after ketamine-isoflurane anaesthesia in goats. Basavaraj (2015) [2] recorded neutrophilia with relative lymphocytopenia in both groups (xylazine +propofol and midazolam + propofol) during anaesthesia in cattle and might have been the result of the stress caused by the pre- anaesthetics and anaesthetic drugs and subsequent stimulation of adrenal gland (Singh *et al.*, 2013) [10]. The changes were nearer to normal levels and was probably related to response of animal to anaesthesia and surgery. Khattri *et al.* (2013) [10] reported significant (p<0.01) increase in neutrophils and significant decrease in the lymphocytes from 15 to 90 min after dexmedetomidine administration in buffalo calves which might be due to the stress caused by the preanesthetic and anaesthetic drugs and subsequent stimulation of adrenal glands. Umar and Wakil (2013) [3] reported significant decrease in neutrophils and non-significant increase in the lymphocytes, monocytes and eosinophils counts after medetomidine- ketamine anaesthesia in goats.

Serum aspartate transaminase and alanine transaminase

In the present study, the values were within normal physiological limits. No significant difference was seen between the groups at all the intervals of the study.

Alanine transaminase and aspartate transaminase fluctuated within normal limits in all animals. Alanine transaminase and aspartate transaminase increased significantly at 24 hours after induction and they remained significantly higher even 48 hours after anaesthesia in midazolam-propofol and xylazine -propofol group of animals by Basavaraj (2015) [47]. Sharma *et al*. (2014) [25] reported increase in the aspartate transaminase levels during late phase of dexmedetomidine-ketamine anaesthesia in dogs. Kumar *et al.* (2016) [49] reported significant increase in the aspartate transaminase levels at 10 minutes and at 24 hours after administration of lorazepam (2 mg/kg, IV) in buffalo calves. Singh *et al.* (1999) [9] reported that atropine-lorazepam-ketamine anaesthesia in goats had no adverse effects on kidney and liver functions during the course of anaesthesia or recovery phase. Kumar *et al.* (2014a) [12] reported significant increase in the aspartate transaminase levels after diazepam-ketamine anaesthesia in buffaloes.

Serum Creatinine

The serum creatinine levels increased non-significantly at 60 minutes after induction of general anaesthesia in goats of both the groups. Increase in serum creatinine in the present study might be attributed to the temporary inhibitory effects of the drugs on renal circulation. Comparison between the groups revealed no significant difference andall the values were within normal physiological limits.

Similar findings were recorded by Nikhit (2017) [20] in goats administered with dexmedetomidine and lorazepam for ketamine-isoflurane anaesthesia. Basavaraj (2015) [2] observed that creatinine values remained within normal limits and no significant change in the values were observed throughout anaesthesia in all animals administered with midazolam-propofol and xylazine -propofol in cattle. Similar findings were recorded after midazolam-ketamine anaesthesia in goats (Abu-Ahmed, 2013) [50] and isoflurane anaesthesia in sheep (Hikasa *et al.*, 2000) [40]. However, increase in the creatinine values were reported after acepromazine-ketamine and diazepam-ketamine anaesthesia in goats, xylazine-butorphanol-midazolam-ketamine anaesthesia in horses (Malik and Singh, 2007) [40] and detomidine-midazolam-ketamine anaesthesia in calves (Nuh, 2008) [51]. Kumar *et al.* (2014b) [12] observed no change in creatinine level after dexmedetomidine-ketamine anaesthesia in goats. Okwudili *et al.* (2014) [21] observed no variation in the creatinine levels after xylazine-ketamine anaesthesia in goats. Steffey *et al.* (1977) [46] observed non-significant increase in the creatinine levels at 60 minutes after isoflurane anaesthesia in foals.

Serum Urea Nitrogen

In our study goats of both groups I and II, non-significant increase in the serum urea nitrogen level at 60 and 120 minutes after ketamine (Group I) and propofol (Group II)-isoflurane anaesthesia was observed. Serum urea nitrogen values fluctuated within normal physiological limits at all intervals of study in both the groups. Similar findings were recorded by Nikhit (2017) [20] in goats administered with dexmedetomidine and lorazepam for ketamine -isoflurane anaesthesia. Reduced renal blood flow and increased hepatic urea production from amino acid degradation could account for the observed increase in plasma urea nitrogen values (Eichner *et al.*, 1979) [5]. Comparison between the revealed no significant difference and all the values were within normal physiological limits. Saxena *et al.* (2001) [24] recorded reduced serum urea nitrogen at 1hr after administration of romifidine-ketamine and continue to fluctuate between 24 to 72 hr. Where as in romifidine- thiopental administered animal SUN remained significantly higher at 1hr and 24 hr. Okwudili *et al.* (2014) [21] observed significant increase in blood urea nitrogen levels at 30 minutes after induction of xylazine-ketamine anaesthesia in goats. Thangadurai *et al*. (2016) [47] observed no significant change in blood urea nitrogen level after induction and during maintenance of xylazine-guafenesin ketamine-isoflurane anaesthesia in cattle. A significant increase in the serum urea nitrogen was observed in cattle administered with midazolam -propofol and xylazine-propofol (Basavraj, 2015) [48]. Kumar *et al*. (2014b) [12] observed non-significant increase in the plasma urea nitrogen after dexmedetomidine -ketamine administration in goats. Sharma *et al*. (2014) [25] observed increase in the blood urea nitrogen levels during late phase of dexmedetomidine-ketamine-halothane anaesthesia in dogs.

Conclusion

Haematological observations revealed that no significant difference was observed between the groups with respect to haemoglobin levels and fluctuated within the normal physiological limits at all intervals of study. Packed cell volume was significantly (p≤0.01) decreased at 60 minutes after administration of general anaesthesia in goats of both the groups. Comparison between the groups revealed no significant difference with respect to packed cell volume at all intervals of study. No significant difference observed in both the groups with respect to total erythrocyte count at all

intervals of study. The goats of both group I and II, significant ($p \leq 0.05$) decrease in total leukocyte count was seen at 60 minutes after induction of general anesthesia. Comparison between the groups revealed that total leukocyte count was non-significantly lower at 60 minutes after propofol-isoflurane general anaesthesia than with ketamine-isoflurane general anaesthesia in goats.

A significant ($p \leq 0.05$) increase in the neutrophils count was seen at 60 minutes after induction of general anaesthesia in both the groups. Comparison between the groups revealed significant ($p \leq 0.05$) increase in neutrophils at 60 minutes in goats with romifidine- propofol-isoflurane anaesthesia than that of romifidine -ketamine-isoflurane anesthesia. Non-Significant reduction in the lymphocyte count was observed at 60 minutes after ketamine-isoflurane anaesthesia in goats of groups I. However, the values were within normal physiological limits. Comparison between the groups revealed no significant difference at all intervals of study. No significant difference observed with respect to monocytes and eosinophils during the study. However, all the haematological fluctuations were within normal physiological limits.

Biochemical observations revealed that the values of serum alanine amino transaminase (ALT), aspartate transaminase, fluctuated within normal physiological limits and no significant difference was observed within the groups and between the groups at all intervals of study. Serum creatinine increased non-significantly at 60 minutes of anaesthesia in goats of both the groups. Non-significant increase in the serum urea nitrogen level at 60 and 120 minutes after ketamine (Group I) and propofol (Group II) -isoflurane anaesthesia was observed. No significant difference observed between the groups at all the intervals of the study all the biochemical values fluctuated within normal physiological limits.

6. References

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