Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

Comparative Evaluation of Tow Doses of Midazolam Combination with Ketamine as General Anesthesia in rabbits

Falah H. Khalaf [1]; Raad Mahmood Hussein[2] and Ahmed H. Alzeheri[2]

1-Department of Surgery and Obstetrics, 2. Department of Internal and Preventive Medicine, College of Veterinary Medicine, University of Diyala.

Received: 1 -12-2023 Accepted: 25-2-2024 Published: 1-3-2024

Abstract

Amis: The study's objective evaluated the anesthesia produced by varying concentrations of midazolam and ketamine on hematological and clinical parameters.
Methods: Twenty mature local breed rabbits, both sexes, were randomly categorized into two groups and with intramuscular injections of midazolam (1 mg/kg BW) and ketamine (30 mg/kg BW) in the first group, and midazolam (3 mg/kg BW) and ketamine (30 mg/kg BW) in the second. They clinically evaluated for 120 minutes, 15-minute intervals starting at zero minutes before to anesthesia. In addition to body temperature, heart rate, respiration rate, analgesia, and muscle relaxation, further variables were also taken into explanation, including the phases of anesthesia (induction of anesthesia, surgical anesthesia, and recovery period).
Results After anesthesia, the clinical respiratory parameters of both groups showed significant differences at the P0.05 level between the evaluation points in the second group and the zero time group. Furthermore, with a significant difference in both groups, a slight drop in rectal body temperature at 30, 45, and 60 minutes after anesthesia. In all groups, there were significant variations in heart rate between zero and 60 and 75 minutes, but not between zero and five minutes. In the categories of RBCs, WBC, HB, and PCV, hematological tests indicated only modest variance with no significant changes; only WBCs after a minute shown a mildly substantial rise concerning control levels.
Conclusion: In the present study, midazolam and ketamine were combined to provide a clinically effective general anesthetic. Both groups recovered quickly and easily, however it seemed that the second group have more time to recover from the anesthesia than the first group required. During induction, there was no apnea or nervousness.
Key word: General anesthesia, Midazolam, Ketamine, Rabbits

How to cite this article
Khalaf, F. H., R. M. Hussein and A. H. Alzeheri (2024). "Comparative Evaluation of Tow Doses of Midazolam Combination with Ketamine as General Anesthesia in rabbits." Diyala Journal for Veterinary Sciences **2**(1).

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

Introduction

For experimental procedures, including mild and short-term handlings, laboratory animals may need to be restrained using chemical or physical substances (1). When handled, rabbits can easily get stressed. So, if the rabbit was already critically ill or debilitated before the restriction was placed, a protracted period of frequent, difficult or aggressive handling might rapidly result in a worsening of its clinical state. Furthermore, if a rabbit is handled incorrectly and tries to flee by kicking or fighting vigorously, this might cause significant injuries such vertebral fractures, subluxations, and lasting damage to the spinal cord (2). For the rabbits to remain healthy, proper management is consequently necessary. The use of sedatives or anesthetic drugs may be helpful to enable the safe conduct of medical procedures such as blood collection, IV catheter setup, radiography, and dental examinations. Rabbits behave differently and are challenging to sedate (3). Analgesia and anesthesia (A&A) are two of the key elements of many procedures performed on laboratory animals. However, evidence suggests that a sizable percentage of study conclusions either misrepresent or use A&A techniques (4). This species' high metabolism and small size contribute to its high death rate. Gut stasis during and after anesthesia can be caused by rabbits' propensity for fermentation in their hindguts (5). The effects of various anesthetic drugs in rabbits have been investigated by several studies; however, ketamine-based combinations for rabbit anesthesia seem to be becoming more and more common due to the drug's safety and potent analgesic properties (4, 6).

In both laboratory and animal settings, ketamine is the most widely used injectable anesthetic (7). The fact that ketamine acts effectively regardless of how it is given. Lower dosages may be utilised for sedation and immobilization during non-surgical procedures. Like in other animal species, ketamine is used in together with pharmaceuticals such as benzodiazepines (diazepam or midazolam) and/or an alpha-2 adrenergic agonist (xylazine or medetomidine) to enhance the anesthetic efficacy of the dissociative agent, improve muscle relaxation, and reduce the dosage (8). Increased analgesia and helpful muscle relaxation (9). The use of midazolam in veterinary anesthesia is gradually replacing that of diazepam because of its superior water solubility, more potent hypnotic activity, and shorter half-life (10). The amount of drug use varies much more among study findings. As an instance, although a number of authors (11, 12) use of 1 mg/kg BW, other researchers (13) and (14) use 3 mg/kg BW of midazolam. In order to determine which of the two dosages was more suitable; **the study's objectives assessed the effects of anesthesia produced by varying concentrations of ketamine and midazolam on hematological and clinical parameters.**

Materials and Methods

In this research, twenty both-sexed adult rabbits aged 8 to 10 months weighing 1.50 0.25 kg were used. Randomly, they were divided into two groups (A and B) of ten rabbits each. The rabbits were housed in controlled conditions and fed green hay in addition to a typical commercial pellet diet that included all necessary minerals and vitamins. They were kept in the college of veterinary medicine's animal house in Diyala, Iraq. There was unlimited access to food and water. Two weeks of acclimatization accompanied a test for the animals. Each rabbit was weighed and received a clinical examination for behavior, respiration, and cardiovascular factors at the day of the experiment. Two doses of midazolam (Sun Pharmaceutical Industries Ltd., India), were given as 1 mg/kg of body weight, and ketamine 30 mg/kg BW (10 g in 50 ml, Fabrique par pharmaceuticals, Holland) in first group(11) and 3 mg/kg of body weight,

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

and ketamine 30 mg/kg BW. in second group (14). The two groups were evaluate over a 120 minutes at intervals of 15 minutes, with adequate muscle relaxation and stable base-line cardiovascular indicators.

Total erythrocyte counts, total leukocyte counts (TLC), differential leukocyte counts, haemoglobin (Hb), packed cell volume (PCV), and erythrocyte sedimentation rate were measured in blood samples obtained with EDTA before anesthesia as a control and after 1hr, 2hrs, and 24 hours.

Haematological studies were subjecte to two-way analysis of variance (ANOVA) using data observation (15).

Result

This method's combination of midazolam and ketamine created a general anesthetic that was clinically effective. In groups A and B, the righting reflex subsided after 3.2 ± 1.00 and 2.0 ± 0.87 minutes, respectively. This combination produced anesthesia in group A in 50.3 ± 4. 68 minutes, and in group B in 61.57 ± 5.40 minutes. There were no convulsions or spasms during recovery.The recovery phase lasted from the moment the anesthesia was stopped, for around 19.0 ± 1.83 minutes in the first group and 28.0 ± 3.4 minutes in the second group, during which the animal stayed in a lateral recumbent position until returning to a sternal position (Table 1). A major drop in heart rate was observed at 15, 30, 45, and 60 minutes in group A when compared to other periods, while a significant decrease was observed at all times when compared to zero minutes in group B. Other than these notable exceptions, the changes in the animals' heart rates were not statistically significant. When anesthesia was administered, the temperature dropped markedly at the P0.05 level. It then continued to decline for a further 75 minutes before rising for an additional 120 minutes, reaching below normal values in both groups. At the P0.05 level, there was a substantial reduction in the clinical respiratory parameters of both groups following anesthesia with significant at the P0.05 level in second group among peroid of examination in compare to zero time. (Table 2).

Table -2. Clinical prameters of the rabbits in the two treated groups

Prameter	Group A	Group B
Induction time/**min**	3.2 ± 1.00	2.0± 0.87
Anesthetic time/**min**	50.3 ± 4. 68	61.57 ± 5.40
Recovery time/**min**	19.0 ± 1.83	28.0 ± 3.4

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

Table -2. Clinical variables for the two treated groups of rabbits

Prameter	Concen-tration	Time							
		Zero time	15 min	30 min	45 min	60 min	75 min	90 min	120 min
Temperature 37-38.04	1mg	38.8± 0.16	38.36± 0.19	37.7± 0.13A	37.54±0.22A	37.7±0.27A	38.48± 0.27A	38.48 ±0.26a	38.55±. 0.46a
	3mg 37-38.48	38.8±0.32 A	38.48±0.27A	38.04±0.25	37.74±0.29A	37.6±0.31A	37.86±0.28A	38.02± 0.35	38.026± 0.39
Heart rate beat/min	1mg	233.2±4.09	217.6±23.5a	166±26.74a	146±25.73a	140.6± 20.76a	147±15.69a	160±19.27a	169.4±20.56a
	3mg	191.6±19.44A	177.2±14.58aA	166±18.91a	145.6±16.54a	139.4± 17.11a	153.2±13.93a	154.2± 20.52a	163.4±22.36a
Respiratory rate/min	1mg	162.4±20.38	43.2±5.82a	34±2.12a	45.2±6.61a	71.4±9.85a	85.2±12.36a	87.8±14.59a	122.8±5.81a
	3mg	102.8±9.34A	108±16.86A	77.6±24aA	57.2±11.54aA	64.4±17.18a	65.2±16.36aA	76±16a	81.6±16.17aA

Values are Mean ± SE. a. Means significance in comparison with 0 hour, significance at P < 0.05, A. Means significance in comparison between groups (1mg and 3mg of Midazolam groups), significance at P < 0.05.

There were no notable changes between the groups that received dosages of 1 mg and 3 mg of midazolam from time zero to time one hour, as determined by the total erythrocyte count results of the current study. As for the hemoglobin results, they showed no significant difference between the two concentrations (1 mg and 3 mg of midazolam). However, the treatment group receiving 1 mg of midazolam showed a significant difference at time 24 hours compared to time 2 hours after starting anesthesia, and at time 1 hours compared to time zero at the initiate of anesthesia, followed by a significant increase at time 2 and 24 hours.

For the A group (1 mg Midazolam) the PCV% results showed a significant decrease at time 24 hours compared to time zero, 1 and 2 hours from the start of anesthesia, while for the 3 mg Midazolam group, the results showed a significant decrease at time 1 and 2 hours compared to time zero at the start of anesthesia, followed by a significant increase at time 24 hours compared to 1 and 2 hours. Furthermore, compared to the group treated with 1 mg, the results indicate a significant decrease in the group administered with 3 mg at times 1, 2, and 24 hours..

For the A (1 mg Midazolam) group, the PCV% results showed a significant decrease at time 24 hours compared to time zero, 1 and 2 hours from the start of anesthesia, while for the 3 mg Midazolam group, the results showed a significant decrease at time 1 and 2 hours compared to time zero at the start of anesthesia, followed by a significant increase at time 24 hours compared to 1 and 2 hours. Furthermore, compared to the group which received 1 mg, the results indicate a significant decrease in the group administered with 3 mg at times 1, 2, and 24 hours.

The MCH results of the 1 mg Midazolam group revealed a significant increase at time 2 hours in comparison to zero time, a significant decrease at time 24 hours in comparison to 2 hours at the beginning of anesthesia, and a significant decrease between groups in the 3 mg Midazolam group in comparison with the 1 mg Midazolam group at time 1 hour. In

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

comparison to the 3mg Midazolam group at zero and one hour, the results of the total white blood cell count at 24 hours revealed a substantial increase (Table 2).

Table -3. Hematological Prameters Of The Rabbits In The Two Treated Groups.

Prameter	Concen-tration	Time			
		Zero Control	1Hr	2 Hrs	24 Hrs
RBC X10^6 ml	1mg	5.20±0.66	4.80±0.63	4.64±0.39	4.75±0.33
	3mg	4.83±0.47	4.45±0.39	4.01±0.12	4.70±0.23
Hb G/DL	1mg	11.68±0.67	11.42±0.52	12.88±1.42	10.76±0.42c
	3mg	10.44±0.88	8.32±0.61aA	10.2±1.68b	10.3±1.26b
PCV %	1mg	34.8±1.85	34±1.34	33.4±1.50	31.8±1.35abc
	3mg	33.6±1.77	24.6±1.80aA	24.6±1.80aA	33.4±3.61bcA
MCV/FL	1mg	72.13±10.53	78.08±12.31	79.92±3.44	67.71±3.33abc
	3mg	69.93±3.66	55.81±2.87aA	85.40±14.86ab	71.33±7.64b
MCHC/FL	1mg	33.54±0.40	33.55±0.45	34.02±0.32	34.84±0.93
	3mg	34.28±1.02	34.97±1.26	41.70±0,62abA	40.08±4.15abA
MCH/PG	1mg	24.20±3.59	25.33±3.95	27.37±1.11a	22.92±1.14c
	3mg	24.78±1.92	18.85±0.86aA	29.31±4.94ab	24.11±3.64bc
WBCX10 ^{3} /ML	1mg	7980±572	6920±715	7160±1080	8980±639A
	3mg	7140±775	6050±596	8990±1137	9010±654ab

Values are Mean ± SE. a. Means significance in comparison with 0 hour, b. In comparison with 1hour , c. In comparison with 2nd hour, significance at P < 0.05, A. Means significance in comparison between groups(1mg and 3mg of Midazolam groups), significance at P < 0.05.

Discussion

Balance anesthesia is achieved by combining many drugs in low doses, which leads to a comfortable induction and recovery with little adverse effects. Using a combination of drugs with different mechanisms of action, as opposed to single ones, improves the analgesic efficacy through synergistic effects without increasing dosage and with minimum adverse effects (16,17). Ketamine use as an anesthetic typically has serious adverse effects, including severe recovery in most species and skeletal muscular stiffness (18). Several injectable agents have been administered to rabbits, including ketamine, which is widely used in veterinary and human medicine to induce anesthesia for surgical procedures. Ketamine is effective by blocking the N-methyl Daspartate receptor in the central nervous system (CNS), which causes the CNS to become

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

less active and decreases the amount of An increase in calcium entering the neuron. But when given to rabbits as the only anesthetic, it usually results in contractions of the skeletal muscles, inadequate analgesic reflex reactions, and an intense recovery from anesthesia (16). We used midazolam, an effective GABA agonist drug, to increase the flow of potassium ions into the cell and counterbalance the negative effects of ketamine by depressing the brain and producing sedative and hypnotic effects (19).

In both groups, the heart rate decreased significantly between 15 and 90 minutes after injection and then returned to normal. These findings were consistent with those of studies (14, 20) which found that ketamine alone caused hyperactivity of cardiopulmonary functions due to its ability to stimulate the central sympathetic outflow, which raises heart and respiratory rates. Ketamine must be used in conjunction with muscle relaxants and analgesics, such as xylazine and midazolam, to mitigate these adverse effects because xylazine has two modes of action: first, it binds to pre-ganglionic alpha-2 receptors with affinity, which reduces catecholamine release at nerve ending(21). While midazolam can cause respiratory depression, and ketamine can cause dysphoric symptoms (such as irritation, depression). There are less adverse effects, memory loss, and quicker analgesia when midazolam and ketamine are combined (22; 23). When high-dose midazolam is added, oxygen desaturation may worsen (24). More ketamine dosages are therefore recommended. The prevalence of oxygen desaturation in some earlier investigations using ketamine and midazolam ranged from 4.8% to 12%.

the clinical study revealed that the lowered body temperature was statistically significant. The anesthetics' inhibition of the thermoregulation center is what causes the reduction in body temperature that was seen in the experimental groups in 45 minutes after the anesthetic was applied. Hypothermia developed as a result of both the ambient temperature and increasing vasodilatation (13, 17, 25).

The results of total erythrocytes count were showed marked decrease in (Red blood cells) 1st and 2nd hours, after administration of 1mg Midazolam and 3mg Midazolam mixed with ketamine. The result was agreed with(26). The results of Pact cell volume PCV, Hb, MCV and MCH decreased over time after the administration of Midazolam but this changes more significant in group treated with 3mg Midazolam than in 1mg Midazolam group. This is similar to the report of (27) and (26), who also reported a significant decrease in PCV, Hb for a short time in all the calves after using detomidine-midazolam-ketamine. The report of Gweba *et al.,* (2010)(28) of decrease in haemoglobin concentration and packed cell volume in goats, agrees with our study. It has been suggested that pooling of circulating blood cells in the spleen and other reservoirs secondary to decreased sympathetic activity to be the reason for decrease in PCV, Hb (29). During anaesthesia or sedation, the decrease in PCV and Hb is attributed to the shifting of fluid from extravascular compartment to intravascular compartment to maintain normal cardiac output in animals (29).

After receiving 3 mg of midazolam combined with ketamine, the total white blood cell count significantly rose after 2 and 24 hours. There was agreement on this outcome (30). After injecting amylobarbitone sodium intraperitoneally, Whose observed a rise in the WBC of the rabbits. Stressful activities like capture and handling can affect leukocyte counts, both total and differential.

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

Neutrophophilic leukocytosis with increases in lymphocytes and monocytes and a slight eosinopenia is the hallmark of epinephrine-induced physiologic leukocytosis in ruminants. Changes brought on by corticosteroids include monocytosis, eosinopenia, amature neutrophilia, and lymphopenia (31). Within 4-6 hours of stress exposure, domestic animals exhibit maxima in neutrophilia and lymphopenia (32, 33).

Conclusion: The current study used ketamine and midazolam together to create a general anesthetic that was clinically successful. Though it appeared that the second group took more time to recover from the anesthetic than the first group carried out, both groups recovered easily and without difficulty. There was neither anxiety nor apnea during induction.

References

1. Graham J .Common procedures in rabbits. (2006). Vet Clin N Am Exotic Anim Pract 9, 367-388.
2. Zeeland Y and Schoemaker N. Current anaesthetic considerations and techniques in rabbits Part I. (2014). EJCAP, 24(4); p19-p30. Go to http://www.fecava.org/ejcap
3. Kim M S, Jeong SM, Park JH, Nam TC, Seo KM. Reversal of Medetomedine – ketamine Combination anesthesia in rabbis by antipamezole. Exp Anim. 53(5):423-8. 2004.
4. Wenger S (2012). Anaesthesia and analgesia in rabbits and rodents. J Exotic Pet Med 21, 7-16.
5. Ali A F. Evaluation of Midazolam and Ketamine Preceding by Xylazine as General Anesthesia in Rabbits. (2013). The Iraqi Journal of Veterinary Medicine, 37(2), 144–148.
6. Brodbelt, D. Perioperative mortality in small animal anesthesia. (2009). Vet J; 182 (2): 152-161.
7. Hall LW, Clarke KW, Trim CM,. Anaesthesia of birds, laboratory animals and wild animals. In veterinary anesthsia. (2000). 10 edition W. B. Saunders: PP: 457 – 466..
8. Fish, R. E. Pharmacology of injectable anesthesia. In: anesthesia and analgesia in laboratory animals. (1997). (Kohn, D.F.; Wixson, SK.; White, WJ. and Benson, GJ. eds) New York , Academic Press. PP:2-27.
9. Alkire M T and Miller J. (General anesthesia and the neural correlates of consciousness. 2005). Progress in Brain Research, 150:229-244.
10. Craven R. Ketamine Anaesthesia. (2007). Vol 2 suppl 1 48-53.
11. Henke J ; Astner S ; Brill T; Eissner B and Busch R. Comparative study of three intramuscular anaesthetic combination (medetomidine/ ketamine, medetomidine/ fentanyl/ midazolam and xylazine/ ketamine) in rabbits. (2005). Veterinary anaesthesia and analgesia. 32: 261-270.
12. Knutson KA, Petritz OA, Thomson AE, Balko JA. Intramuscular Alfaxalone-Butorphanol-Midazolam Compared with Ketamine-Butorphanol- Midazolam in New Zealand White Rabbits. (2022) . J Am Assoc Lab Anim Sci. 1;61(5):475-481. doi: 10.30802/AALAS-
13. Ali, A. F. Evaluation of Midazolam and Ketamine Preceding by Xylazine as General Anesthesia in Rabbits. (2013). Iraq. J. Vet. Med., 37(2), 144–148. https://doi.org/10.30539/iraqijvm.v37i2.274.
14. Atalan G, Atalan G, Erol H, Erol M, Atasever A, Doğan Z, Güneş V, Yönez MK, Keleş I. Comparison of Systemic Effects of Midazolam, Ketamine, and Isoflurane Anaesthesia in Rabbits. (2019) J. Vet. Res. 12;63(2):275-283.

doi: 10.2478/jvetres-2019-0035. PMID: 31276068; PMCID: PMC6598192.

15. SPSS .Statistical package for the social science version 13 .(2008). users guide spssinc, Chicago 3, using.. Web site http:/www.spss.com.
16. Mahmood M B. A comparison between ketamine-xylazine and ketamine-midazolam or all of them to induce balance anesthesia in rabbits.(2022). Iraq. J.Vet. Sci. Vol. 36, No. 2, :(499-506).
17. Hall L, Clarke K, Trim C. Veterinary anesthesia. (2001).10th ed. London: WB Saunders;. 156-158.
18. Abdullah K , Nuri A; Logman A; Bahtiyar B; Nazmi Y. Evaluation of the anesthetic effects of xylazine-ketamine, xylazine-tiletaminezolazepam and tiletamine-zolazepam using clinical and laboratory parameters in rabbits. (2018). Med Weter.;74(10):646-652. DOI:10.21521/mw.6119.
19. Sabrina S, Sabine T, Brian G, Julia H. Comparison of physiological parameters and anesthesia specific observations during isoflurane, ketamine- xylazine or medetomidine-midazolam-fentanyl anesthesia in male guinea pigs. (2016). PLoS One.;1-22. DOI: 10.1371/journal.pone.0161258
20. Oguntoye C O; Oyewande O A, and Afolabi O.O. Evaluation of Tramadol-Midazolam-Ketamine Anaesthesia in Rabbits. (2018).Niger. J. Physiol. Sci. 33. 145-149.
21. Dupras J, Vachon P, Cuvelliez S, Blais D. Anesthesia of the New Zealand rabbit using the the combination of tiletamine-zolazepam and ketamine-midazolam with or without xylazine. (2001). Canadian Vet. Journal= La Revue Veterinaire Canadienne. 1;42(6):455-60.
22. - Parker RI, Mahan RA, Guigliano D, Parker MM. Efficacy and safety of intravenous midazolam and ketamine as sedation for therapeutic and diagnostic procedures in children. (1997). Pediatrics 99:427-431.
23. - Pellier I, Mongrial JP, Le Moine P, Rod B, Rialland X, Granry JC. Use of intravenous ketamine-midazolam association for pain procedures in children with cancer: a prospective study. (1999). Paediatrics Anaesth;9:61-68.
24. Cheuk DK, Wong WH, Ma E, Lee TL, Ha SY, Lau YL, Chan GC. Use of midazolam and ketamine as sedation for children undergoing minor operative procedures. Support Care Cancer13(2005).:1001-1009.
25. Grint NJ, Murison PJ. Peri-operative body temperatures in isoflurane-anaesthetized rabbits following ketamine–midazolam or ketamine–medetomidi ne. Veterinary anaesthesia and analgesia. 2007 May 1;34(3):181-9.
26. Khalaf, F H.; AL-Zuhairi, A H.; AL-Mutheffer, E A. . Clinical and hematological effect of acepromazine, midazolam, ketamine as general anesthetic protocol in rabbits. (2014). Int. J. Sci. Nat., v.5, p.328-331.
27. Grint N J and Murison P J. A comparison of ketamine- midazolam and ketamine-medetomidine combinations for induction of anaesthesia in rabbits. (2008). Vet. Anaesth. Analg., 35: 113-121.
28. Gweba M, Onifade KI & Faleke OO Effect of xylazine sedation on some clinico-physiological and haematological parameters in Sokoto red goats. (2010). Nigerian Veterinary Journal, 31(2) 177-181.
29. Kilic N. Cardiopulmonary, biochemical, and hematological changes after detomidine-midazolam-ketamine anesthesia in calves. (2008). Bull V et. Inst. Pulawy.. 52:453-456.
30. Elsa AT, Osunkwo U A. and Onyeyili P A. Effect of sodium amylobarbitone on some haematological and biochemical parameters in rabbits. (2002). J. Agri. Environ., 3: 43-48.

Diyala Journal for Veterinary sciences
Open Access Journal Published by College of Veterinary Medicine
University of Diyala, Iraq
P-ISSN: 2410-8863
E-ISSN:2958-6178
Vol. 2, NO. 1, March 2024

31. - Taylor, J. A. Leukocyte responses in ruminants. (2000). *In* Schalm's veterinary hematology, 5th Ed, Feldman, B. F., Zinkl J. G.and Jain, N. C. (eds.). Lippincott Williams &Wilkins, Philadelphia, Pennsylvania, PP: 391–404.

32. -Jain, N.C. Essentials of Veterinary Hematology. (1993). 1st ed: Lea and Febiger Publication, Philadelphia, PP: 589- 595.

33. Umar M A and Waki Y. Efects of the combination of ketamine and medetomidine anesthesia on hematological parameters in sahel goats. (2013). Sok. J. Vet. Sci. 11: 66-69.