
Research Paper

Efficacy of Different Anesthetic Cocktails During Scrotal Sac Ablation Surgery in Rams and Bucks

Muhammad Abid Hayat^{1*}, Shehla Gul Bokhari¹, Muhammad Arif Khan¹,
Hafiz Muhammad Qasim¹, Abid Hussain Shahzad², Bilal Muhammad Shahid,
Asif Iqbal³ and Zawar Husain³

¹*Department of Clinical Medicine and Surgery,
University of Veterinary and Animal Sciences, Lahore 54000, Pakistan*

²*Department Clinical Sciences, Section of Theriogenology,
College of Veterinary Sciences Jhang 35200, Pakistan*

³*Department of Parasitology, University of Agriculture Faisalabad 38040, Pakistan*

**Corresponding Author: abidbagra.uvas@gmail.com*

ARTICLE HISTORY

Received: July 01, 2016

Revised: August 17, 2016

Accepted: September 30, 2016

Key Words:

Injectable anesthesia

Gas anesthesia

Xylazine

Ketamine

Midazolam

Isoflurane

Ram Buck

Clinical pathology

Ultrasonography

ABSTRACT

The study was carried out to evaluate the effect of Xylazine, Ketamine and Midazolam as injectable anesthesia and isoflurane gas anesthesia on pathological parameters in Rams and Bucks. Animals were divided into three groups (n=4) group A, B and C each having 4 animals. All animals were pre-medicated with atropine sulphate at the dose rate of (0.1-0.4 mg/kg, I.M). Prior to surgery, the testis of each animal was scanned using B-mode Sonography to assess the changes in testicles. Blood cell counts and plasma biochemical analysis were performed before anesthesia (control group), during anesthesia and after recovery undergoing scrotal sac ablation surgery. An increase in WBC, platelets, and lymphocyte ($P \leq 0.05$) and decrease in total red blood cell count was recorded during anesthesia and after recovery. There were no significant changes in hemoglobin

All copyright reserved to Mr. Scholar

To Cite This Article: HAYAT, M.A., S.G. BOKHARI, M.A. KHAN, H.M. QASIM, A.H. SHAHZAD, B.M. SHAHID, A. IQBAL and HUSAIN, Z. (2016). Efficacy of different anesthetic cocktails during scrotal sac ablation surgery in rams and bucks. Scholar's Adv. Anim. Vet. Res., 3(3): 95-107.

and creatinine. Aspartate aminotransferase, alkaline phosphatase, and gamma-glutamyl transpeptidase were not significantly changed at any sampling point. There was highly significant BUN in group C as compared to other group. Before surgery ultrasonographic analysis showed that testicular swelling which caused variation in length and width; abscess formation was common and a diffuse, patchy, hypo echoic parenchyma pattern; furthermore, the scrotal wall was thickened, usually accompanied with testicular and epididymal enlargement. The mean value of specific all parameters LFT and RFT and CBC shows that Injectable xylazine anesthesia was used alone leads to profound bradycardia. For short-term procedures the combination of midazolam and ketamine prove more efficacious. Isoflurane anesthesia was the safest anesthetic agent in geriatric or weak animals for longer procedure.

INTRODUCTION

Sheep as well as goat upbringing has been a main basis of earnings on behalf of a standard person. Sheep and goat population in Punjab Pakistan replicated by 3.64 and 9.35 million heads, correspondingly. These animals are of scrupulous value because they give in the figure of meat, milk, wool as well as hides. Additionally, these species supply fertilizer to improve the soil (Shah *et al.*, 2013).

However, during the season of heavy rainfall in the Punjab province minor unattended testicular wounds become contaminated owing to negligence on part of owner. Generally, cases with severe adhesion formation and chronic orchitis are presented at the Surgery Indoor Hospital with the need to perform a scrotal sac ablation.

During a veterinary hospital practice, through significantly high number of surgical cases, the

technique used for the management of anaesthetics agents should be uniform for the minimal recovery time in animals, so that the animals have to bear minimum cardiovascular, hepatic and renal distress because of different anaesthetic drugs used. This necessitates make use of short acting injectable and volatile anaesthetics agents to minimize recovery time from anaesthesia after surgical intervention (Arras *et al.*, 2001).

Xylazine, pharmacologically confidential furthermore skeletal muscle relaxant, In horses, dogs and sheep, soon after intravenous injection (Mogoa *et al.*, 2000). Xylazine is a specific alpha-2 agonist of the non-opioid group, containing analgesic, sedative and muscle relaxing property (Sumitra *et al.*, 2004).

Likewise the recently introduced volatile anaesthetics, mainly isoflurane as well not much side effects on cardiovascular system (CVS), renal as well as hepatic functions (Asoka net *et al.*, 2006). Isoflurane is efficient in addition to generally available anaesthetics and has been found to protect the myocardium commencing ischemic harm. Isoflurane prevents neutrophil and platelet adhesion to the endothelium and to influence reperfusion damage via modulating the assembly of reactive oxygen species (Bignami *et al.*, 2013). Isoflurane as well as sevoflurane have been to be less hepatotoxic than halothane (Yuan *et al.*, 2012).

Ketamine hydrochloride can make changes in the hemogram and blood chemistry of anesthetized patient (Nagarajan *et al.*, 2007). Ketamine has led to widespread of agent for maintenance of anaesthesia (Bovill *et al.*, 2008).

Midazolam acts as a muscle relaxant and hypnotic as well as an anticonvulsant. It is used in sedation and; tranquilization, and additionally for treatment of muscle fasciculation induced through additional anaesthetics (Cheryl and Blaze, 2004).

MATERIALS and METHODS

The present study was conducted on 12 animals (rams or bucks) presented for scrotal sac ablation. All animals were thoroughly examined to rule out any anomaly prior to study and allocated into three treatment groups, viz. groups A, B and C, with 4 animals in each group. Blood samples collected were taken before surgery whereas considered as a control group.

All three groups were pre-medicated with atropine sulphate at the dose rate of (0.1-0.4 mg kg⁻¹, I.M). Group (A) Animals were sedated by using xylazine HCl (0.05-0.1 mg kg⁻¹ (Xylaz[®], Farvet Laboratories' Netherlands), intravenously, through the jugular vein of the animals; group (B) was sedated with xylazine (Xylaz[®], Farvet Laboratories' Netherlands), followed by induction, maintenance with midazolam (Dormicum[®], Martin Dow Pharmaceuticals (Pak) Ltd. @ 0.05-0.25 mg kg⁻¹) and ketamine (Ketasol[®], Indus Pharma Pvt. Ltd., Pakistan) @ 2-4 mg kg⁻¹, IV. Group (C) xylazine (Xylaz[®], Farvet Laboratories' Netherlands), was given as sedative followed by induction and maintenance performed with isoflurane (Forane[®], Abbot Pharma Pvt. Ltd. @ (4.5%) inhalation anesthesia with oxygen flow rate of 4L min⁻¹.

Prior to surgery, the testes of each animal were scanned using B-mode sonography and scrotal sac ablation surgeries were subsequently performed in the three groups using the respective anesthetic agents allocated for each group. Surgical intervention was performed at Surgery Indoor Hospital, UVAS Lahore. All the essential preoperative considerations were satisfied. Individual health conditions of all the animals were properly examined. All the Animals Rams and Bucks were properly examined clinically and physically. Pulse rate, respiratory rate and body

temperature were checked to be normal. All the animals were dewormed using Albendazole (Zental suspension; of Smith Kline Becham) at the rate 10 mg kg⁻¹ body weight orally. For the elimination of external parasites, all the animals were specified clean up using Trichlorophon (Segavon[®], Symans Pharmaceuticals Ltd. Pakistan). All the clinical animals were housed in an aseptic environment in the available place at the Surgery Section, Department of Clinical Medicine and Surgery, University of Veterinary and Animal Sciences, Lahore, during the examination period. The animals were kept off-feed 12 h prior to the surgeries. The medication protocol was adopted pre and post-surgically. Antibiotic was administered 24 hours prior to all the surgeries. For this purpose, Inj. Amoxivet[®] (ICI, Pakistan) was used at 10-20 mg kg⁻¹ I/M body weight of the animals. Antibiotic administration was continued for 6-7 days after surgery to prevent infection. Inj. Loxin[®] (Nawan Pharma, Pakistan) was used prior to each surgery as an analgesic (NSAID). Dosage used was 1 ml/45kg I/M (Slatter, 2002). For an aseptic approach, Povidone iodine scrub (Pyodine Surgical[®], Brookes) was used for surgical site preparation prior to each surgical exercise. Post-operatively, the wound was regularly dressed using povidone-iodine antiseptic 60 ml @ cost of Rs.17.48 (Pyodine[®], Brookes). During anesthesia monitoring, the vitals of each animal, as well as reflexes were monitored just by touching the palpebral borders with the index finger to assess the degree of sedation. Respective surgeries were performed after achieving of the surgical stage of anesthesia. Furthermore, during the surgeries, I/V lines were maintained and Ringer Lactate was given at the dose rate of 10 mL/kg/hr to each animal to combat dehydration.

A day prior to the surgery, the operative site was clipped and shaved off properly. On the day of

surgery, medicated soap solution was used to ascertain sanitation of the surgical site. After properly cleaning, the animal was brought to the operation theatre. The animal was positioned on the surgical table in dorsal recumbency. Scrubbing of the surgical site was completed using povidone surgical scrub 60 ml @ cost of Rs.17.48 (Pyodine Surgical[®], Brookes Pharma, Pakistan). Scrubbing was done to build the area complimentary from microbes.

Circular fashion scrubbing was done early from the center of the surgical site towards outward.

Hygienic surgical drapes were positioned around the surgical site leaving a rectangular window release at the planned incision area. Draping of the surgical site was done in two layers using sterile surgical drapes. In the first layer, drapes were cited in a four-drape fashion, and clamped to patient skin using towel clamps. In the second layer, a drape with a central opening was positioned on top of the area of interest (Slatter, 2003).

For ascertaining an aseptic surgical approach, sterilized surgical gowns in addition to sterilized non-refundable surgical gloves, caps, masks were worn before the surgical procedure. Hands and arms of the surgeon, assistant surgeon and table assistants were scrubbed properly with six minutes' scrubbing protocol before touching the sterilized surgical dress (Slatter, 2003). All surgical instruments together with drapes, scissors, forceps, needle holders, scalpel handles, trays as well as bowls which had been sterilized through autoclaving one day before surgery, were arranged on a movable trolley by a scrubbed assistant, prior to surgery, keeping care of asepsis. For sterilization of the instruments autoclaving was performed a day prior to the surgery.

Scrotal sac ablation surgeries of rams and bucks suffering from orchitis, were done as per standard technique, discussed as follows:

The goats were castrated surgically following standard procedures (Tyagi and Singh, 1996).

An incision was made parallel to the median raphae down the anterior surface of the scrotum. The testicle was lifted out of the scrotum. A ligature was tied (chromic catgut 2/0) around the spermatic cord as well as the cord was severed distal to the ligature. The testicle was once removed. The second testicle was lifted out of the scrotum through the previous incision and the procedure of removal was repeated as per for the first testicle. The peritoneum was closed with interrupted 3-0 or 2-0 absorbable sutures (Vicryl) and the sub cutaneous layer was opposed with a simple continuous pattern using 3-0 or 2-0 absorbable sutures. While non-absorbable simple interrupted 3-0 or 2-0 sutures were used on the skin incision (Olson *et al.*, 2000).

The goats were permitted to recover 10-15 min, from anesthesia. For post-operative maintenance, an average of 500 mL Ringer lactate solution infusion was given intravenously, to avoid dehydration as well as acidosis in the first week. Antibiotic was administered 24 hours prior to all the surgeries, for this principle Inj. Amoxivet[®] (ICI, Pakistan) was given at 10-20 mg/kg I/M body weight of the animals. Antibiotic administration was continued for 6-7 days after surgery to avoid infection. Inj. Loxin[®] (Nawan Pharma, Pakistan) was administered prior to each surgical procedure as a potent analgesic (NSAID). Dosage used was 1 mL 45kg⁻¹ I/M (Slatter, 2002). The wound was cleaned and dressed on a daily basis using povidone-iodine solution 10% (Pyodine[®], Brookes Pharma, Pakistan), till complete healing of the wound as well as removal of non-absorbable simple interrupted 2.0 skin sutures. All through the post-operative period, the behavior, TPR, feeding, defecation along with urination of the animals was frequently checked. Blood sampling was done, before, during anaesthesia as well as after recovery from anesthesia. Blood sampling were taken before

surgery was considered as a control group. Each blood sample was additionally processed at Quality Operations Laboratory at UVAS Lahore. Blood samples (3 mL each) were in use from the jugular vein by using 22-gauge IV catheter just before induction of anaesthesia, during the stage of surgical anaesthesia (i.e. during the surgery) as well as after recovery 10-15 min from anaesthesia. Biochemical profile estimation tests were conducted for renal function tests (Serum Uric acid, creatinine, (blood urea nitrogen) BUN) and liver function tests (Serum bilirubin, ALT, AST and alkaline phosphatase) by using automatic serum analyser.

Data analysis: The data were composed and analyzed via using SPSS version 16. Mean and standard error designed for numeric variables i.e. values of LFT, RFT and CBC. ANOVA was applied on quantitative variables to find out the difference in efficacy of the four drugs. P value <0.050 was measured as significant (H. Zar., 2007).

RESULTS AND DISCUSSION

Hematological analysis indicated that there was a non-significant increase in WBC, platelets and lymphocyte ($P \leq 0.05$) in sheep and goats during anaesthesia and after recovery. While total red blood cell count was non-significantly decreased during anaesthesia and after recovery in sheep and goats. There were no significant changes in hemoglobin and creatinine. Aspartate aminotransferase, alkaline phosphatase, and gamma-glutamyl transpeptidase were not significantly changed at any sampling point. There was highly significant BUN in group C as compared to other group. All the results were shown in the Table. 1, 2 and 3. Camkerten *et al.* (2013) used ketamine-xylazine anaesthesia in Bozova Greyhounds and non-significant results of serum biochemical parameters. Ankur and Bhardwaj (2010) used xylazine or midazolam before propofol anaesthesia in dogs and observed their

results on hemato-biochemical parameters which were non-significant. The findings of all above studies were similar with the results of present study.

The rise in ALP and bilirubin was experimental in three groups but rise in these parameters was more in xylazine as well as xylazine-ketamine and midazolam treated group as compared to in animals treated with isoflurane. The increase in these values showed that xylazine-ketamine may influence liver more as compared to isoflurane (Gil *et al.*, 2002). But significantly higher value of blood urea nitrogen were established to be significantly higher in the xylazine ketamine as well as midazolam treated groups as compared to isoflurane group. This increase in BUN values may be due to changes in blood pressure after ketamine-xylazine midazolam injection as it resulted in decreased renal blood flow moreover decreasing the glomerular filterate rate with accordingly raising BUN and creatinine levels. Post induction gradual increase in creatinine level in our animals were alike in three groups because he said that glomerular filtration decreases in turn raising the creatinine level.

Liver enzymes including AST, ALP and GGT were not-significantly affected in sheep and goats (Ismail *et al.*, 2010). Comparative increase in AST, ALP and GGT has been reported in sheep, calves and horses subsequent extended halothane anaesthesia due to the induction of hepatic microsomal enzymes through halothane (Steffey *et al.*, 1993; Rajaian *et al.*, 2008).

Administration of isoflurane had no effect on hepatic enzyme activities whereas; there was small boost in AST value by ketamine-xylazine administration (Thompson *et al.*, 2002). Post-operative renal as well as hepatic function was affected by isoflurane and sevoflurane in term of serum creatinine, BUN, urinary protein and glucose excretion, ALT and AST between anaesthetic groups remains constant 24-72 hr (Kharasch *et al.*, 2001).

Table 1: Hematological and plasma biochemical values (ME±SE) in Rams and Bucks following group A- xylazine-xylazine anesthesia (n=4)

Parameter	Time of Sampling		
	Before Surgery	During Surgery	After Surgery
AST (U/IL)	70.7±1.5	88.50±3.79	89.50±7.81
ALT (U/IL)	15.50±5	28.75±1.7	26.50±0.6
GGT (U/IL)	28.7±1.2	27.60±1.07	26.32±0.58
ALP (U/IL)	1.13E2±0	1.2E2±2.95	1.2E2±10.5
BILIRUBIN(mg/dl)	0.1±0.05	0.325±0.13	0.275±0.07
BUN (mg/dl)	11.2±0.4	18.30±0.82	18.325±0.8
CREATININE (mg/dl)	0.8±0.08	1.85±0.02	1.87±0.02
URIC ACID (mg/dl)	0.15±0.8	0.12±0.04	0.15±0.05
RBC (10 ⁶ / Ul)	12.7±1.7	13.72±1.32	12.22±1.22
WBC (10 ⁶ /ul)	9.8±0.54	8.32±0.78	7.82±0.32
Lymphocyte (10 ³ /ul)	7.5±0.47	6.92±0.51	5.61±0.78
Platelets (10 ³ /ul)	7E3±E3	7.5105E3±2.1E3	9.49653±2.8E2
Haemoglobin(g/dl)	9.80±0.4	8.59±0.30	7.17±0.88

Table 2: Hematological and plasma biochemical values (ME±SE) in Rams and Bucks following group B- xylazine-Ketamine-Midazolam anesthesia (n=4)

Parameter	Time of Sampling		
	Before Surgery	During Surgery	After Surgery
AST (U/IL)	70.50±15.78	84.75±5.61	86.25±4.21
ALT (U/IL)	15.50±1.32	27.75±1.60	32.50±2.17
GGT (U/IL)	25.50±3.27	31.10±3.18	32.40±4.63
ALP (U/IL)	1.145E2±6.51	1.295E2±2.39	1.2175E2±10.49
BILIRUBIN(mg/dl)	0.14±0.04	0.35±0.14	0.275±0.025
BUN (mg/dl)	11.70±0.61	17.45±1.26	19.60±0.55
CREATININE (mg/dl)	0.80±0.12	1.82±0.04	1.90±0.04
URIC ACID (mg/dl)	0.10±0.00	0.05±0.02	0.17±0.02
RBC (10 ⁶ / Ul)	11.20±0.93	12.21±1.05	9.49±0.35
WBC (10 ⁶ /ul)	9.49±0.30	7.79±0.29	7.34±0.20
Lymphocyte (10 ³ /ul)	5.57±0.45	5.95±0.69	4.01±0.29
Platelets (10 ³ /ul)	7.2345E3±2.1233E3	9.7492E3±2.5008E2	9.7490E3±2.5000E2
Haemoglobin(g/dl)	9.52±0.90	6.79±0.05	7.13±0.60

Table 3: Hematological and plasma biochemical values (ME±SE) in Rams and Bucks following group C- xylazine-Isoflurane anesthesia (n=4)

Parameter	Time of Sampling		
	Before Surgery	During Surgery	After Surgery
AST (U/IL)	70.25±16.26	79.75±6.04	78.50±4.09
ALT (U/IL)	16.00±0.70	24.75±1.88	26.75±3.68
GGT (U/IL)	25.25±3.03	30.25±2.94	27.87±2.82
ALP (U/IL)	1.1475E2±6.28	1.275E2±15.15	1.19E2±18.26
BILIRUBIN(mg/dl)	0.15±0.06	0.275±0.10	0.225±0.047
BUN (mg/dl)	11.15±0.79	11.97±0.27**	12.17±0.45**
CREATININE (mg/dl)	0.82±0.06	1.72±0.11	1.85±0.06
URIC ACID (mg/dl)	0.10±0.04	0.10±0.00	0.10±0.04
RBC (10 ⁶ / Ul)	11.27±0.95	12.49±20.01	9.80±0.27
WBC (10 ⁶ /ul)	9.51±0.29	8.92±0.04	7.66±0.22
Lymphocyte (10 ³ /ul)	7.32±0.18	6.53±0.45	4.76±0.50
Platelets (10 ³ /ul)	8.9E3±4E3	9E3±4.7319E2	9.74E3±2E2
Haemoglobin(g/dl)	9.35±0.40	7.50±0.91	6.47±0.2

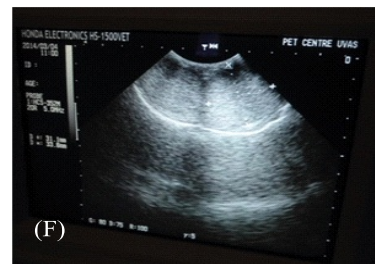
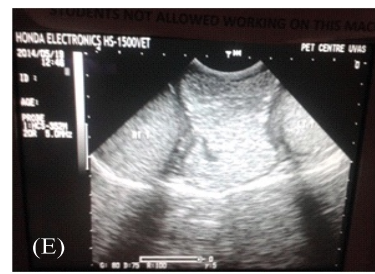
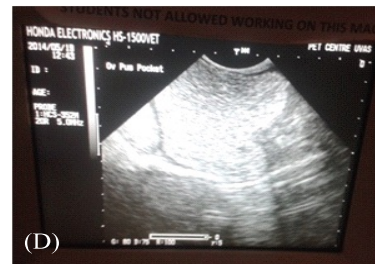
** Indicate the significant changes p<(0.05)

Ankur and Bhardwaj (2010) used xylazine or midazolam before propofol anesthesia and (Mukati *et al.*, 2006) injected xylazine or acepromazine before propofol anesthesia in dog as well as outcome showed non-significant changes in serum creatinine. Ismail *et al.* (2010) used xylazine-ketamine in sheep and goat and results showed non-significant changes in serum creatinine like the results of present study. The results of present study were different from the results of Chauhan and Pandey (2006) that used fentanyl and ketamine in dogs and observed significant increase in BUN and serum Creatinine but in present study using xylazine-ketamine-midazolam and isoflurane values of serum creatine showed non-significant and value of BUN showed significant value ($P < 0.05$). This difference in results might be due to the use of different sedative drugs and due to species difference than our study.

In the present study, the values of red blood cells, haemoglobin, lymphocyte and white blood cells show slight decrease from the initial base line value in xylazine-ketamine-midazolam and xylazine-isoflurane treated group but this change was not significant ($P < 0.05$) but the value of red blood cells and white blood cells were increase from initial base line in xylazine treated group but these changes were in normal ranges and similarly the value of platelets non-significantly increase after surgery. Tobias and Schertel (1992), Atalan *et al.* (2002) and Gulamber *et al.* (2001) used xylazine and ketamine in dogs and found non-significant changes in the values of red blood cells, white blood cells and hemoglobin. Kilic (2008) administered Detomidine-midazolam ketamine anesthesia in calves and set up different results from the present day. He found significant decrease in red blood cells as well as hemoglobin after umbilical surgery. This variation in results from the present study was due to pooling of blood cells in spleen as well as other reservoir organ secondly because of species difference.

Sonograms were also obtained in the lateral recumbency with the help of 7.5 MHz curvilinear transducer through B-mode Ultrasonography (Aloka JAPAN S900), in order to assess the ultrasonographic testicular changes undergoing scrotal sac ablation surgery. Sonograms were recorded prior to surgery. In the all groups, Group A, Group B and Group C shows hyper echoic parenchyma, decreased blood flow at the affected area, testicular swelling which caused variation in length and width; abscess formation was common and characterized by an irregular hyperechoic wall and anechoic to hypoechoic central contents and a diffuse, patchy, hypo echoic parenchyma pattern; furthermore, the scrotal wall was thickened, usually accompanied with testicular and epididymal enlargement. (Hamm, 1997) said that Testicular atrophy usually grows after severe forms of orchitis as well as, prolonged courses. An abscess is imagined as a bounded, significantly hypoechoic /anechoic lesion within inflamed areas of the testis Diffuse, inhomogeneous and pronounced hypo-echogenicity combined with clinical signs of inflammation is indicative of diffuse abscess-forming inflammation. The differential diagnosis is Especially difficult in chronic orchitis. Fever and pain are often absent, and palpation may reveal a firm mass indicative of tumor. Karaca *et al.* (1999) Said that the abscesses usually involve the head of the epididymis, but may spread to include the body then tail of the epididymis, separately. The testis is fixed within fibrous tissue reaction as well as, is abundant condensed in size and looks more hypo-echoic than normal and contains many hyper-echoic spots consistent with testicular atrophy.

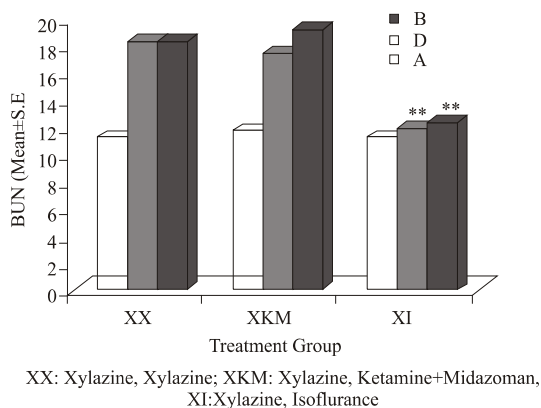
Sonogram of Client own Ram (Group A-xylazine - xylazine treated group), evidence of thick scrotal wall, hyper echoic parenchyma wall and variation in length and width of testicle measured in above Figure A shows the affected testicle, sonogram taken pre-operatively. Figure B shows Sonogram of client own ram (Group A xylazine-



xylazine treated group), evidence of thick scrotal wall in right testicle slightly hyperechoic parenchyma and shows the decreased blood flow at the affected area, sonogram was taken pre-operatively. Sonogram of client own ram (Group B- xylazine-ketamine- and midazolam treated group), evidence of Testicular atrophy which measured sonographically in form of length, width and depth in above Figure C.

Sonogram of client owned ram (Group C- xylazine-isoflurane treated group), in Figure E. evidence of abscess formation in both testicle characterized by an irregular hyperechoic wall and anechoic to hypoechoic central contents and a diffuse, patchy, hypo echoic parenchyma pattern;

furthermore, the scrotal wall was thickened, usually accompanied with testicular enlargement, sonogram was taken pre-operatively. Figure D showed the Sonogram of client own Buck (Group B- xylazine-ketamine and midazolam treated group), evidence of pus formation in testicle characterized by an irregular hyperechoic wall and anechoic to hyper echoic central contents and a diffuse, patchy, hyper echoic parenchyma pattern. Sonogram of Client own buck (Group B xylazine ketamine and midazolam treated group), evidence of hyper-echoic thick scrotal wall, hyper echoic parenchyma wall and variation in length and width of testicle measured in above figure F showed the affected testicle, sonogram taken pre-operatively.



ACKNOWLEDGEMENTS

The author would like to say words of thanks to Dr. Shehla Gul Bokhari Assistant Professor in Surgery Department for her nice cooperation in processing of samples in the field conditions.

REFERENCES

AHMED, S.A. and AHMED, E.A. (2011). Behavioral responses of castrated buck kids at different ages by using different methods of castration. *J. Am. Sci.* 7 (5):200-209.

AJADI, R., A. OWANIKIN, M. MARTINS and GAZAL, O. (2012). Effect of epidural tramadol and lignocaine on physiological and behavioural changes in goats subjected to castration with a high tension band. *NZ Vet J.* 60 (6): 344-348.

ALI, A., M.A. ULLAH and EJAZ, M.A. (2013). Evaluation of Livestock Data Using Multivariate Analysis Techniques.

AL-SOBAYIL, F.A., A.F. AHMED, N.A. AL-WABEL, A.A. AL-THONAYIAN, F.A. AL-ROGIBAH, A.H. AL-FUAIM, A.O. AL-OBAID and AL-MUZAINI, A.M. (2009). The use of xylazine, ketamine, and isoflurane for induction and maintenance of anesthesia in ostriches (*Struthio camelus*). *J. Avi. Med. Surg.*, 23 (2): 101-107.

ASOKAN, R., J. HUA, K.A. YOUNG, H.J. GOULD, J.P. HANNAN, D.M. KRAUS, G. SZAKONYI, G.J. GRUNDY, X.S. CHEN, M.K. CROW and HOLERS, V.M. (2006). Characterization of human complement receptor type 2 (CR2/CD21) as a receptor for IFN α : A potential role in systemic lupus erythematosus. *J. Immunol.*, 177: 383-394.

ASA AKINEA, H.S., YOSHIKI HAYASHIDAB, YUZO KATOA (2001). Effects of ketamine and propofol on autonomic cardiovascular function in chronically instrumented rats. *Autonom Neuro s*, 87, 201-208.

ARRAS, M., P. AUTENRIED, A. RETTICH, D. SPAENI and RULICKE, T. (2001). Optimization of intraperitoneal injection anesthesia in mice: drugs, dosages, adverse effects, and anesthesia depth. *Comp. Med.* 51:443-456.

AKSOY, M., H. ERDEM, F. HATIPOGLU, N. LEHIMCIOGLU, O. AKMAN and OZKAN, K. (2009). Ultrasonographic examination of the scrotal content in the rabbit. *Reprod Domest Anim.* 44 (1): 156-160.

ALFREDO GONZALEZ GIL, ALBERTO VILLA, PILAR MILLAN, LETICIA MARTINEZ-FERNANDEZ and JUAN C ILLERA. (2010a). Serum Biochemical Response to Inhalant Anesthetics in New Zealand White Rabbits. *JALAAS*, 49, 52-56.

ALFREDO GONZALEZ GIL, GEMA SILVAN, PEDRO LUIS LORENZO and MARIANO ILLERA. (2010b). Changes in Hepatic and Renal Enzyme Concentrations and Heart and Respiratory Rates in New Zealand White Rabbits after Anesthetic Treatments. *JALAAS*, 41, 30-32.

- BIGNAMI, E., T. GRECO, L. BARILE, S. SILVETTI, D. NICOLOTTI, O. FOCHI, E. CAMA, R. COSTAGLIOLA, G. LANDONI, G. BIONDI-ZOCCAI and ZANGRILLO, A. (2013). The effect of isoflurane on survival and myocardial infarction: a meta-analysis of randomized controlled studies. *J. Cardiothorac Vasc Anesth.* 27 (1): 50-58.
- BOVILL, J.G. (2008). Inhalation anaesthesia: from diethyl ether to xenon. *Handb Exp Pharmacol* 182:121-142.
- BONELLI, P., C. DIMAURO, S. PAU, M. DATTENA, A. MOLLICA and NICOLUSSI, P. (2008). Stress responses in lambs castrated with three different methods. *Ital. J. Anim. Sci.*, 7 (2): 207-217.
- CHETCUTI, K., K. LAM and BELFIELD, J.C. (2013). Testicular, epididymal and adnexal ultrasound: A pictorial review. Part 1: Testicular ultrasound. *Ultrasound.* 21 (2): 64-73.
- EVAN, D., KHARASCH, EDWARD, J. FRINK, JR. ALAN ARTRU, PIOTR MICHALOWSKI, G. ALEC ROOKE, WALLACE NOGAMI, (2001). Long-Duration Low-Flow Sevoflurane and Isoflurane Effects on Postoperative Renal and Hepatic Function. *Anesth Analg.* 93, 1511-1520.
- CHERYL, A. and BLAZE, M.M.G. (2004). *Veterinary Anesthesia Drug Quick Reference*, 1st Edition : 74-75.
- DUNDEE, J. and N. HALLIDAY *et al.* (1984). Midazolam. *Drugs* 28(6): 519-543.
- DZIKITI, T.B. and G.E. ZEILER *et al.* (2014). The effects of midazolam and butorphanol, administered alone or combined, on the dose and quality of anaesthetic induction with alfaxalone in goats: Original research. *J. Sou. Afr. Vet. Asso.*, 85(1): 1-8.
- DZIKITIA, T. and G. STEGMANNA *et al.* (2009). Sedative and cardiopulmonary effects of acepromazine, midazolam, butorphanol, acepromazine-butorphanol and midazolam-butorphanol on propofol anaesthesia in goats. *J. Sou. Afr. Vet. Asso.*, 80(1): 10-16.
- FERNANDO, S.F. A.B.C. CRUZ, G. ALCEU RAISER, MARINA ZIMMERMAN, RAFAEL LUKARSEWSK and RENATA P.B. STEFFEN (2010). Total intravenous anesthesia with propofol and S(+)-ketamine in rabbits. *Vet Anaesth Analg.* 37, 116-122.
- GIFFIN, J.L., S.E. FRANKS, J.R. RODRIGUEZ-SOSA, A. HAHNEL and BARTLEWSKI, P.M. (2009). A study of morphological and haemodynamic determinants of testicular echotexture characteristics in the ram. *Exp. Biol. Med.* 234 (7): 794-801.
- GRUB, J.B., J.C. THURMON, W.O. OLSON, W.J. TRANQUILLI, J.H. FOREMAN, P.D. CONSTABLE and DAVIS, L.E. (1997). Effects of xylazine / ketamine on cardiac function and serum ionised calcium in horses. *Vet. Anaesth Analg.* 24(2): 6-11.
- GULANBER, E.G., A. BASTAN, I. TASAL, M. AKTAS and ARIKAN, N. (2001). Kopeklerde Midazolam ve ketaminle Genel Anestezisi. *IU Vet. Fak. Derg.* 27(2): 401-409.
- HAHN, R.G., L. BRAUER, P. RODHE, C.H. SVENSEN and PROUGH, D.S. (2006). Isoflurane inhibits compensatory intravascular volume expansion after hemorrhage in sheep. *Anesth Analg.* 103 (2): 350-358.
- HAMM, B. (1997). Differential diagnosis of scrotal masses by ultrasound. *Europ radio* 7(5): 668-679.
- ISMAIL, Z. B. and K. JAWASREH *et al.* (2010). Effects of xylazine-ketamine-diazepam anesthesia on blood cell counts and plasma biochemical values in sheep and goats. *Comparative Clinic. Pathol.*, 19(6): 571-574.

- JERROLD, H ZAR. (2007). Biostatistical analysis: 161-176.
- JENNIFER OFFINGER, H.M., JESSICA FISCHER, SABINE, B.R. KASTNER, MARION PIECHOTTA and JUERGEN REHAGE. (2012). Comparison of isoflurane inhalation anaesthesia, injection anaesthesia and high volume caudal epidural anaesthesia for umbilical surgery in calves; metabolic, endocrine and cardiopulmonary effects. *Vet. Anaesth. Analg.* 39, 123-136.
- ILKER CAMKERTEN, NIHAT SINDAK, GUZIN OZKURT, HUDAI IPEK, HALIL S. BIRICIK, TEKIN SAHIN (2013). Effect of ketamine-xylazine Anesthesia on some hematological and serum Biochemical values of Bozova Greyhounds. *Harran Uni. Vet. Fak Derg*, 2(1): 27-31.
- JEYAKUMAR, S., A.K. DE, A. KUNDU, K. ROY, SUNDER J, KUNDU M, BALAKRISHNAN M, CHAND S, AHMED, S. (2013). Sonographic characteristics of goat testis on water bath based ultrasonography. *Livest Sci.* 152 (1): 79-87.
- DUPRAS, J.P.V., S CUVELLIEZ and BLAIS, D. (2001). Anesthesia of the New Zealand rabbit using the the combination of tiletamine-zolazepam and ketamine-midazolam with or without xylazine. *The Canadian Vet. J.*
- JAMES, W. SULIBURK KENNETH S. HELMER EAG, EMILY K. ROBINSON and DAVID W. Mercer (2005). Ketamine attenuates liver injury attributed to endotoxemia: Role of cyclooxygenase-2. *J surg*, 138, 134-140.
- JULIA HENKE, S.A., THOMAS BRILL, BARBARA EISSNER, RAYMONDE BUSCH and WOLF ERHARDT (2005). Comparative study of three intramuscular anaesthetic combinations (medetomidine/ ketamine, medetomidine/fentanyl/midazolam and xylazine/ketamine) in rabbits. *Vet. Anaesth Analg*, 32, 261-270.
- KERR, C.L., C. WINDEYER, L.P. BOURE, K.K. MIRAKHUR and MCDONELL, W. (2007). Cardiopulmonary effects of administration of a combination solution of xylazine, guaifenesin and ketamine or inhaled isoflurane in mechanically ventilated calves. *Am. J. Vet. Res.*, 68 (12): 1287-1293.
- KIM, J.K., N.Y. YI, E.S. LEE and SEO, K.M. (2004). Original Articles: Effect of intratesticular injection of xylazine/ketamine combination on canine castration. *Korean J Vet Res.* 5 (2): 151-155.
- LOMAX, S., H. DICKSON, M. SHEIL and WINDSOR, P.A. (2010). Topical anaesthesia alleviates short-term pain of castration and tail docking in lambs. *Aust Vet. J.* 88 (3): 67-74.
- MELCHES, S., S.C. MELLEMA, M.G. DOHERR, B. WECHSLER and STEINER, A. (2007). Castration of lambs: a welfare comparison of different castration techniques in lambs over 10 weeks of age. *Vet. J.* 173 (3): 554-563.
- MELCHES, S., S.C. MELLEMA, M.G. DOHERR, B. WECHSLER and STEINER, A. (2007). Castration of lambs: a welfare comparison of different castration techniques in lambs over 10 weeks of age. *Vet. J.*, 173 (3): 554-563.
- MOGOA, E., G. STEGMANN, A. GUTHRIE and SWAN, G. (2000). Clinical, cardiopulmonary and haemocytological effects of xylazine in goats after acute exposure to different environmental temperature and humidity conditions. *JSA Vet. Assoc.* 71 (3): 153-159.
- MORGES, M.A., K.R. GRANT, C.M. MACPHAIL and JOHNSTON, M.S. (2009). A novel technique for orchietomy and scrotal ablation in the sugar glider (*Petaurus breviceps*). *J. Zoo. Wildl Med.* 40 (1): 204-206.
- NISHIYAMA, T., T. FUJIMOTO and HANAOKA, K. (2004). A comparison of liver function after hepatectomy in cirrhotic patients between sevoflurane and isoflurane in anesthesia with nitrous oxide and epidural block. *Anesth Analg.* 98 (4): 990-993.

- NORMAN, M., K. TOMSCHA and WEHR, M. (2012). Isoflurane blocks temporary tinnitus. *HearRes.* 290 (1): 64-71.
- NAGARAJAN, P., R. VENKATESAN, M.J. KUMAR and MAJUNDAR, S.S. (2007). Effects of Ketamine and thiophene anesthesia on serum lipid parameters in adult bonnet monkeys (*Macaca radiata*). *J. Am. Assoc. Lab Anim. Sci.* 46(3): 3-21.
- OLSON, MERLE E, BRUCE and JIM (2000). Ovariectomy, Ovariohysterectomy and orchidectomy in rodents and rabbits. *Can Vet. J.* 27 (12): 496-501.
- PANG, W., B. EARLEY, T. SWEENEY and CROWE, M. (2006). Effect of carprofen administration during banding or burdizzo castration of bulls on plasma cortisol, in vitro interferon- γ production, acute-phase proteins, feed intake and growth. *J. Anim. Sci.*, 84 (2): 351-359.
- SCHULZ, C., M. RITZMANN, A. PALZER, K. HEINRITZI and ZOLS, S. (2007). Effect of isoflurane inhalation anesthesia on postoperative pain due to castration of piglets. *Berl Munch Tierarztl Wochenschr.* 120 (5-6): 177-182.
- SLATTER, D. (2003). Textbook of small animal surgery (3rd Edition). Elsevier Science. USA. PP 446-469.
- SHAH, Z., A. KALHORE, A. KACHIWAL, I. AHMAD, H. SATTAR, M. KHAN, Z. REHMAN, F. KHAN, T. HUSSAIN and ULLAH, H. (2013). Comparative studies on sedative and analgesic effects of xylazine and detomidine in goats. *JAPS.* 23 (1 Suppl): 39-42.
- SOLAKANI, R.S. (2012). Ruminant Surgery, 2nd Edi, CBS Pub. The Genital System : 275-276.
- STOFFEL, M.H., A. VON ROTZ, M. KOCHER, M. MERKLI, D. BOESCH and STEINER, A. (2009). Histological assessment of testicular residues in lambs and calves after Burdizzo castration. *Vet. Rec.*, 164 (17): 523-527.
- SCOTT, P. (2012). Applications of diagnostic ultrasonography in small ruminant reproductive management. *Anim. Reprod Sci.* 130 (3): 184-186.
- SLATTER, (2002). Textbook of Small Animal Surgery, 3rd Edition. Pain management for surgical patients. Page 2511.
- SUMITRA, M., P. MANIKANDAN, K.V. RAO, M. NAYEEN, B.M. MANOHAR and PUVANAKRISHNAN, R. (2004). Cardiorespiratory effect of diazepam-ketamine, xylazine-ketamine and thiopentone anesthesia in male wister rats: a comparative analysis. *L. Sci.*, 75 (15): 1887-1896.
- TING, S., B. EARLEY, J. HUGHES and CROWE, M. (2003). Effect of ketoprofen, lidocaine local anesthesia and combined xylazine and lidocaine caudal epidural anesthesia during castration of beef cattle on stress responses, immunity, growth, and behavior. *J. Anim. Sci.*, 81 (5): 1281-1293.
- GRUBB, T. L.G.J.B., J. C. THURMON, W.O. OLSON, W. J. TRANQUILLI, J. H. FOREMAN, P. D. CONSTABLE and L.E. DAVIS (1997). Effects of xylazine/ketamine on cardiac function and serum ionised calcium in horses. *Vet. Anaesth Analg.* 24, 6-11.
- TOMOKI NISHIYAMA, T.F. and KAZUO HANAOKA (2004). A Comparison of Liver Function After Hepatectomy in Cirrhotic Patients Between Sevoflurane and Isoflurane in Anesthesia with Nitrous Oxide and Epidural Block. *Anesth analg.* 98, 990-993.
- THOMPSON, J.S.B., A. STEPHEN, K H U R D A Y A N , V A L A R I E ZEYNALZADEGAN, AMENAH; SULLIVAN, PATRICK G. SCHEFF and STEPHEN W. (2002). Early Effects of Tribromoethanol, Ketamine/Xylazine, Pentobarbitol and Isoflurane Anesthesia on Hepatic and Lymphoid Tissue in ICR Mice. *JALAAS*, 52, 63-67.

- Umar, M.A. and Adam, M.K. (2013). Effect of combination ketamine-medetomidine anesthesia on hematology and serum chemistry parameters in dogs. *Nigerian Vet. J.* 34 (3):808-813.
- YANG, J., C.Y. GONG, Y.F. CHAI, N. LUO, N.F. LUO and LIU, J. (2008). Model establishment for emulsified isoflurane delivered selectively to the goat spinal cord and preliminary research on the immobility mechanism of isoflurane. *Sichuan Da Xue Xue Bao Yi Xue Ban.* 39 (2): 259-262.
- YUAN, Z., J. LIU, X. LIANG and LIN, D. (2012). Serum biochemical indicators of hepatobiliary function in dogs following prolonged anaesthesia with sevoflurane or isoflurane. *Vet. Anaesth Analg.* 39 (3): 296-300.
- HIKASAA, Y.K.S., K. TAKASEB and S. OGASAWARAB (2002). Clinical, cardiopulmonary, hematological and serum biochemical effects of sevourane and isourane anesthesia in oxygen under spontaneous breathing in sheep. *Small Rumi Res* 36,241-249.
- ZHANKUI, YUAN J.L., XIUTING LIANG and DEGUI LIN (2012). Serum biochemical indicators of hepatobiliary function in dogs following prolonged anaesthesia with sevoflurane or isoflurane. *Vet. Anaesth Analg.* 39, 296-300.