ASSESSMENT OF SOME ANESTHETIC REGIMENS FOR GENERAL ANESTHESIA IN EQUINE

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ABSTRACT

Fifteen healthy adult experimental donkeys weighted about (150 – 200 kg) were used in this study. These Animals were housed in Surgery Clinic of Mansoura Veterinary Teaching Hospital and were premedicated intravenously with xylazine Hcl (1.1mg/kg). In addition, eighteen animals (9 horses and 9 donkeys) anesthetized for a variety of clinical surgical procedures. Five minutes later, anesthesia was induced and maintained with one of the following combinations. Xylazine Hcl (0.5 mg/ ml), guaifenesin (50 mg/ ml) and ketamine Hcl (2 mg/ ml) in 1 liter of warm dextrose 5 % (group I), xylazine Hcl (0.5 mg/ ml), guaifenesin (50 mg/ ml) and thiopental sodium (4 mg/ ml) in 1 liter of warm dextrose 5% (group II) and xylazine Hcl (0.5 mg/ ml), midazolam (0.04 mg/ml) and ketamine Hcl (2 mg/ml) in 1 liter of dextrose 5% (group III). The anesthetic quality (induction, degree of analgesia, muscle relaxation, sedation and quality of recovery), cardiopulmonary effects, hematology, blood chemistry and blood gases were estimated in all groups. All compared anesthetic protocols showed smooth induction. The quality of sedation, analgesia and muscle relaxation in XGK and XMK groups were good to excellent. The quality of recovery was smooth and good to excellent in XGK and XMK groups, while it was moderate in XGT group. All compared anesthetic protocols are suitable to induce and maintain appropriate safe state of anesthesia under field conditions in equidae.

INTRODUCTION

Total intravenous anesthesia (TIVA) has been defined as a technique that utilizes IV-administered drugs to produce and maintain unconsciousness, analgesia and muscle relaxation without concurrent use of inhalant agents. TIVA has been used for many years and still today. It represents the most common anesthetic technique used for surgical procedures in the field **(Robertson, 1997)**.

Not all anesthetic drugs provide all of the desired features of anesthesia. For example, barbiturates (e.g. thiopental), are drugs that provide general anesthesia and muscle relaxation but do not have analgesic effects. On the other hand, ketamine has excellent analgesic effects but does not induce muscle relaxation and disnot a complete anesthetic when used alone. For these reasons, ketamine is always used in combination with heavy sedation and often combined with a

benzodiazepine (e.g. midazolam) to produce a greater degree of central depression and improve muscle relaxation **(Thurmon and Benson, 1987)**.

Hubbell (1999) mentioned that, guaifenesin 5% solution can be combined with xylazine and ketamine to produce solution that is called "triple drip". The latter is formulated by liter of 5% guaifenesin and adding 1000 to 2000 mg of ketamine and 500 mg of xylazine. The combination is administered to effect up to area of 1ml /kg body weight /h This produces excellent muscle relaxation and suitable analgesia.

The use of various combinations of sedative-analgesic (xylazine), muscle relaxant (guaifenesin or midazolam) and dissociative anesthetic (ketamine) drugs for total intravenous anesthesia to induce anesthesia for short period (usually <60 minutes). This gives also well-preserved cardiovascular function, adequate muscle relaxation and analgesia and good to excellent quality of induction, maintaince and recovery **(Matthews et al., 1991 and Muir et al., 2000)**.

Taylor et al. (2008) said that, GKX combination produces safe and satisfactory total intravenous anesthesia in donkeys for use under field conditions. Donkeys require higher amounts of ketamine in GKX to achieve satisfactory anesthetic levels without producing excessive depression with guaifenesin.

The combination of guaifenesin 5% and thiopental 5mg/kg allows light anesthesia with slight palpebral, corneal reflexes and noticeable muscle relaxation for up to 1 hour **(Matthews et al., 1991)**. Recovery feature and length are directly proportional to the total dose used. The anesthetic effects of barbiturate drugs may persist longer in aged, debilitated, dehydrated, or diseased horses. The guaifenesin - thiopental mixture is an acceptable alternative for TIVA and is reasonably inexpensive **(Muir, 1991)**.

The purpose of the present study was to evaluate the anesthetic quality (induction, degree of analgesia, muscle relaxation, sedation and quality of recovery), cardiopulmonary effects, hematology, blood chemistry and blood gases produced by (Xylazine -Guaifenesin- Ketamine), (X ylazine - Guaifenesin- Thiopental) and (X ylazine - Midazolam- Ketamine) in experimental donkeys and in clinical cases (premedicated with xylazine Hcl 2%) anesthetized for a variety of surgical intervention.

MATERIAL AND METHODS

Anesthetic regimens:

The subject of this study was 33 animals classified into experimental part (15 donkeys) and clinical one (18 animals) including (9 donkeys and 9 horses) anesthetized for a variety of clinical surgical procedures as (Herniorraphy, pythiosis, castration, lacerated flexor tendons repair, removal of hypergranulation tissue and removal of alar cartilage). Experimental animals were premedicated with xylazine 2 % in a dose of 1.1 mg/kg given intravenously. Anesthesia was induced by rapid administration of each combination till the animals became recumbent. Infusion rate was reduced to 2ml/kg/hr **(Matthews and Vandijk, 2004)**.

Group I : Xylazine -Guaifenesin- Ketamine (XGK) :

Anesthesia was induced and maintained by infusion of a freshly prepared mixture of 500 mg xylazine Hcl (0.5 mg/ ml) (Xylaject 2% Adwia, Egypt), 50 gm guaifenesin (50 mg/ ml) (Guaifenesin - Life science, USA.) and 2 gm ketamine Hcl (2 mg/ ml) (Ketran 5% - Eimc pharmaceutical, Egypt.) in 1 liter of warm dextrose 5 %.

GroupII : Xylazine -Guaifenesin- Thiopental (XGT):

Anesthesia was induced and maintained by infusion of a freshly prepared mixture of 500 mg xylazine Hcl (0.5mg/ml), 50 gm guaifenesin (50mg/ml) and 4 gm thiopental sodium (4 mg/ml) (Thiopental - E.P.I.C.O pharmaceutical, Egypt) in 1 liter of warm dextrose 5%.

Group III : Xylazine - Midazolam - ketamine(XMK):

Anesthesia was induced and maintained by infusion of a freshly prepared mixture of 500 mg xylazine Hcl (0.5 mg/ ml), 40 mg midazolam (0.04mg/ml) (Mediathetic, Amoun pharmaceutical, Egypt) and 2 gm ketamine Hcl (2 mg/ml) and in 1 liter of dextrose 5%.

Assessment of anesthesia :

I- The depth of anesthesia was assessed through :

1- Presence or absence of reflex responses to stimuli (the palpebral, corneal, anal, tail, skin and oropharyngeal reflexes). These reflexes were recorded at 5, 15, 30 and every 15 minutes during the period of anesthesia according to **(Ez-Eldien et al., 1996)**.

2- The quality of analgesia, sedation and of muscle relaxation were recorded at 5, 15, 30 and every 15 minutes during the period of anesthesia according to **(Taylor et al., 2001 and Taylor et al., 2008)**.

3- The quality of induction and quality of recovery were recorded according to **(Taylor et al, 2001)**.

4- Vital parameters :

The rectal temperature, heart rate/minute, respiratory rate/minute and capillary refill time/second were measured at 5, 15, 30 and every 15 minutes during the period of anesthesia.

5- Blood parameters :

Venous blood samples were collected from jugular vein of all animals before anesthesia and during anesthesia and after recovery.

The samples were subjected to:

A) Hematological examination:

Counting of red blood corpuscles (RBCS), white blood corpuscles (WBCS), hemoglobin (Hb) and packed cell volume (PCV) according to **(kilic, 2004)**.

B) Serum analysis:

(SGOT) and (SGPT) **(Steffey et al., 1980)** serum creatinine and serum urea nitrogen **(Watson et al., 2002)**. Na, K and glucose **(Watson et al., 2002)** and cortisol in serum according to **(Luna & Taylor, 1995)**.

6) Blood gases analysis

An arterial blood sample was drawn from transverse facial artery and analyzed immedi-

ately for blood gases (Pao 2, Paco 2) **(Muir et al., 2000)**.

9) Time to sternal and time to standing were measured.

II) Statistical analysis:

The data were analyzed by either two or one-way ANOVA **(Bastage et al., 2007)**. For all analysts, value of ≥ 0.05 was considered significant.

RESULTS

Intravenous administration of xylazine in experimental donkeys was associated with lowering of head, lower lip droop, and reluctance to move with mild ataxia. Protrusion of the penis was observed in 2 male donkeys. Frequent urination was also observed in 3 cases within (45-90 minutes).

1- Effects of the used three injectable anesthetic protocols on vital signs:

Reflexes: Palpebral and corneal reflexes were normal during the period of anesthesia from (5-90) minutes in GI and GIII. While they were normal at 5 minutes, sluggish from 15 to 45 minutes and absent from 60 to the end of anesthetic period in GII. Anal, tail, skin and oropharyngeal reflexes were sluggish to abscent during the period of anesthesia. Heart rate values were shown in table (3). HR showed initial increase followed by gradual decrease in all groups. Respiratory rate values were shown in table (4). RR decreased to reach the lowest values at 60 minutes in all groups. Capillary refill time values were shown in table (5). CRT in all groups showed steady increase throughout the whole period of anesthesia. Rectal temperature values were shown in table (6). RT in all groups showed steady reduction throughout the whole period of anesthesia.

2- Effects on analgesia, sedation and muscle relaxation :

Quality of analgesia was judged to be good to excellent in all donkeys in GI and GIII while analgesia was judged to be poor in the frist 15 minutes, good at 30 minutes and excellent from 45 to 90 minutes in GII. Quality of sedation was judged to be good to excellent in all donkeys in GI and GIII while sedation was judged to be poor in the frist 15 minutes, good from 30 mins to 45 mins and excellent from 60 to 90 mins in GII. Quality of muscle relaxation was judged to be good to excellent in all donkeys in GI and GIII while it was judged to be poor in the frist 15 minutes, good from 30 mins to 45 mins and excellent from 60 to 90 mins in GII (table, 7).

3- Effects on quality of induction, time to sternal, time to standing and recovery : All anesthetic inductions were smooth and excitement free and received a classification score of good to excellent. Donkeys were injected with approximately 95 ml, 135 ml and 75 ml of infusion to accept lateral recumbency in Gt, GII and GIII, respectively. Quality of recovery was judged to be good to excellent in GI, GIII and poor to moderate in GII. Mild to moderate ataxia was observed after standing in GIII. Time to sternal was longer in GII than GI and GIII. Time to standing was longer in GII than GI and GIII (table, 8).

4- Effects on pao 2 and paco 2 : Pao 2 values were significantly decreased after injection of anesthesia while, Paco2 values were

significantly increased after injection of anesthesia (table, 9).

5- Effects on RBCs, WBCs, PCV and Hb : RBCs, WBCs, Hb and PCV showed significant decrease during anesthesia then followed by significant increase after recovery with no statistical differences between groups (table, 10).

6- Effects on serum chemistry : Serum GOT and GPT were significantly decreased during anesthesia following injection. They were significantly increased after recovery. Serum BUN was significantly increased during anesthesia following injection then significantly decreased after recovery. Serum creatinine was significantly increased during anesthesia following injection and after recovery. Serum glucose, cortisol and Na were significantly increased during anesthesia following injection then gradual decreasc after recovery. Serum K was significantly increased during anesthesia and after recovery. There were no statistical differences between the tested groups (table, 11).

DISCUSSION

The intravenous anesthetic drugs are considered to be the primary means of chemical restraint in veterinary praetice **(Robertson, 1997)**. TIVA under field conditions is preferable as it produces reliable and safe anesthesia, performed without facilities, achieved calm induction and anesthesia, recovery without excitation and without danger for the horse or helping personnel **(Luna et al., 1996)**.

The present results revealed that donkeys in all groups take largc amount of infusion to be 26% higher than that used for the horse to accept lateral recumbency. Donkeys require the dose of injeetable anesthetic drug to be 30% higher than that used for the horse due to donkeys eliminate drugs faster than horses **(Matthews and Van Dijk, 2004)**.

Palpebral and corneal reflexes in this study were active in XGK and XMK groups. This may be due to the effect of ketaminc **(Hubbell, 1996)**. These results were agreed with **(Young et al., 1993)**. The reflexes were active at the beginning of anesthesia then become sluggish to abscent in XGT group, which were in agreement with **(Muir, 1991)**. Anal, tail, skin and oropharyngeal reflexes in this work were sluggish to absent in all groups. This could be attributed to addition of an adjunctive agent for muscle relaxation as _2-adrenoceptor agonist, benzodiazepine (midazolam) and alternatively, guaifenesin which resulted in depression of these reflexes **(Muir, 1991)**.

The groups (XGK, XGT and XMK) in this study showed significant decrease in heart rate. This result was similar to that reported by **(Brouwer et al., 1980 and Muir & Hubbell, 1995)** who recorded that xylazine produces marked bradycardia. Respiratory rate was decreased in all groups of the current study. This may be due to respiratory depressant effect of xylazine **(Dart, 1998)**. Similar results were observed by **(Browuer, 1985; Muir et al., 2000)**. Capillary refill time was increased in all groups of the present work. This could be attributed to the effect of guaifenesin **(Brouwer, 1985)** and midazolam **(Gangle et al., 2001)** which induce a significant decrease in systolic, diastolic and mean arterial blood pressure. Rectal temperature

was decreased during anesthesia in all groups of the present study. This result was in agreement with **(Luna and Taylor, 2001)** who attributed this decrease to the decrease in metabolic rate and the depression of the hypothalamic thermoregulatory center by _2 adrenoceptor agonist .

The PaCo 2 values remained within aeceptable range during anesthesia in all groups, while Pao2 values were decreased. Similar results were observed by **(Yamashita et al., 2007)**. The latter recorded that the reduction of pao 2 during MKM-TIVA attributed to the combinatton of intrapulmonary vaseular shunting and ventilation perfusion mismatching.

The quality of analgesta in XGK and XMK groups was good to excellent. This may be due to the analgesic effect of xylazine **(Greene and Thurmon, 1988)** as well as ketamine **(Muir, 1991)**. While quality of analgesia in XGT group was poor at the beginning of anesthesia and good to excellent from (t30- t90) minutes. **Matthews et al. (1992)** added that thiopental is known to have poor analgesic effects in donkeys thus it needs to be combined with xylazine to improve analgesia.

The quality of muscle relaxation was good to excellent in XGK and XMK groups while in XGT group, it was poor at the beginning of anesthesia then become good to excellent. This may be due to muscle relaxant effect of xylazine **(England and Clarke, 1996)**, guaifenesin **(Herschel et al., 1992)** and midazolam **(Reves et al., 1985)**. The quality of sedation in XGK and XMK groups was good to excellent. while in XGT group, it was poor at the beginning of anesthesia then become good to excellent. This could be attributed to the sedative effect of xylazine **(Greene and Thurmon, 1988)** and midazolam **(Jeffrey, 1998)**.

The quality of recovery in XGK and XMK groups was ranged from good to excellent. This could be attributed to the rapid and extensive redistribution of ketamine from central to peripheral compartments **(Wright, 1982)**. The quality of recovery in XGT group was poor to moderate. Thiopental was found to have cumulative effect that is why the recovery period was long **(Taylor, 1999 and Hall et al., 2001)**.

Ataxia has been recorded in animals anesthetized with XMK group. Similar results were found by **(Gangle et al., 2001 and Yamashita et al., 2007)** who reported that ataxia was caused by a lingering muscle relaxant effect of midazolam after short periods of anesthesia. Recovery time in donkeys in all groups was shorter than horses. This could be attributed to the rapid elimination of drugs in donkeys than horses **(Matthews and Van Dijk, 2004)**. It was longer in XGT group than XGK and XMK groups. This may be due to the cumulative effect of thiopental **(Taylor, 1999)**.

RBCS. WBCS. Hb and PCV were decreased in all groups of the current study. This result was coincided with the result obtained by **(Steffey et al., 1980 and Robertson., 1987)** who stated that. this decrease could be attributed to the pooling of circulating blood cells in the spleen. Also, it may be due to the shifting of the fluid from extra vascular compartment to intravascular compartment during the period of anesthesia or seda-

tion to maintain normal cardiac out.

GOT and GPT were increased in all groups. This observations were coincided with **(Koichev et al., 1988)** who mentioned that, horses anesthetized with diazepam and ketamine produced significant elevation of GOT and GPT. However, it is difficult to describe this to possible liver damage, because all the reported values were within accepted limit. BUN and creatinine were significantly elevated in all groups of the present work . Similar result was recorded by **(Watson et al., 2002)** who mentioned that, this rise might be attributed to the temporary inhibitory effect of diazepam, ketamine and isoflurane in horses on the renal blood flow which in turn might caused rise in plasma.

Glucose was elevated in all gronps of the current work. This may be due to hyperglycemia results from inhibition of insulin secretion from panereatic _ cells which mediated by xylazine **(Dart, 1998)**. Cortisol in all groups was within normal limits in experimental cases but significantly elevated in elinical eases. These results were agreed with **(Taylor et al., 1998)** who mentioned that the increase in experimental study after detomidine, ketamine and guaifenesin in ponies may be due to the apprehension of animals from a strange environment but in elinical study the increase seen immediately after the start of surgery related to the surgical stimulation. The elevation of Na and K percent in all groups was identical with the results of **(Watson et al., 2002)**. The latter said that the decrease in renal plasma flow and glomerular filtration rate is associated with increased plasma sodium concentration. Also, significant elevation of K was due to _2 adrenoceptor - mediated which increase release of K from cells **(England and Clarke, 1996)**.

All compared anesthetic protocols are suitable to induce and maintain appropriate safe state of anesthesia under fleld conditions in equidae. Although the longest recovery time and poor quality of recovery were observed only in XGT and MGT groups. Ketamine anesthetle combinations (XGK, XMK and MKM) were excellent for debilitating animals as they induee mild cardiopulmonary depression, good to excellent and smooth recovery.

Table (1): Scoring system for the quality of analgesia, sedation and degree of muscle relaxation.

Classification score	Quality of analgesia	Quality of sedation	Degree of muscle relaxation.
Excellent (4 degrees)	No response	Calm, relaxed, no restraint required, minimal response to environmental stimuli, reluctant to move	No trunk or limb twitching or movement, no resistance to flexion of limbs.
Good (3 degrees)	Minimal response (nystagmus for e.g.).	No restraint required, infrequent response to environmental stimuli, easily waked without problem.	Slight trunk or limb muscle twitching, minimal resistance to flexion of limbs.
Moderate (2 degrees)		Minimal restraint required, reactive to noise and sudden movement.	Strong trunk or limb muscle twitching, resistance to flexion of limbs.
Poor (1degree)	Much response (voluntary movement of the head and neck for e.g.)	Unsatisfactory, no signs of sedation, nervousness.	Muscle rigidity and strong resistance to flexion of limbs.

Table 2 : Illustrated by scoring system for quality of induction and quality of recovery from anesthesia.

Classification score	Quality of induction	Quality of recovery
Excellent (4 degrees)	smooth, timely transition to lateral recumbency, good muscle relaxation	horse stand smoothly on first attempt with very little ataxia
Good (3 degrees)	smooth, timely transition to lateral recumbency minor fascial or limb movement	horse stands fairly smoothly with 1-2 attempts and obvious ataxia
Moderate (2 degrees)	slight delay in transition to lateral recumbency with increase in muscular rigidity or limb movement	horse stands fairly with 3 or more attempts, ataxia, and some difficulty.
Poor (1 degree)	increased muscular activity before and during transition from standing to lateral recumbency	horse requires assistance to stand

Table (3): Showed the effects of the tested anesthesia up to 90 minutes after injection on **heart rate** per minute (Mean + SD).

Group	T 0	T 5	T 15	T 30	T 45	T 60	T 75	T 90
I (XGK)	36.80± 5.1	37.00±6.6	35.80±6.54	35.60±5.1	34.80±5.5	32.40±5.02	34.40±4.1	34.60±3.0
II (XGT)	46.40±8.8	48.40±5.1	43.20±6.2	42.60±6.1	40.20±8.8	40.80±9.3	44.40±9.3	46.40±12.7
III (XMK)	39.20± 7.5	40.80±8.7	41.20±9.7	38.80±7.9	37.60±8.8	37.20±7.0	37.20±7.1	37.60±7.4

Table (4) : Showed the effects of the tested anesthesia up to 90 minutes after injection on **respiratory rate** per minute) Mean ± SD).

Group	T 0	T 5	T 15	T 30	T 45	T 60	T 75	T 90
I (XGK)	18.00± 4.6	18.00± 8.7	16.40± 8.8	14.80±7.29	14.60±7.7	17.80±7.53	18.20±2.8	18.00±3.7
II (XGT)	22.40±5.8	18.00±4.6	14.80±4.8	14.80±4.8	16.00±5.02	17.20±5.9	18.80±7.6	19.40±4.6
III (XMK)	18.80±5.8	18.60±4.6	18.00±4.8	14.80±4.89	15.80±5.02	16.00±5.93	17.20±7.61	18.80±8.17

Table (5) : Showed the effects of the tested anesthesia up to 90 minutes after injection on **capillary refill time** per minute (Mean ± SD).

Group	T 0	T 5	T 15	T 30	T 45	T 60	T 75	T 90
I (XGK)	2.280±0.43	2.420±0.39	2.640±0.35	2.740±0.23	2.800±0.49	2.940±0.4	3.040±0.38	3.160± 0.3
II (XGT)	2.240±0.40	2.420±0.27	2.560±0.27	2.580±0.27	2.880±0.22	3.080±0.08	3.240±0.46	3.280±0.43
III (XMK)	2.360±0.23	2.360±0.29	2.740±0.52	2.840±0.62	3.060±0.47	3.200±0.16	3.460±0.37	3.560±0.41

Table (6): Showed the effects of the tested anesthesia up to 90 minutes after injection on **rectal temperature** per minute (Mean ± SD).

Group	T 0	T 5	T 15	T 30	T 45	T 60	T 75	T 90
I (XGK)	37.58±0.25	37.04±0.43	36.84±0.35	36.86±0.27	36.84±0.26	36.78±0.51	36.64±0.66	36.68±0.37
II (XGT)	37.44±1.1	37.24±0.78	37.04±0.54	36.82±0.67	36.82±0.63	36.84±0.45	36.64±0.32	36.68±0.43
III (XMK)	37.68±0.605	37.58±0.61	37.36±0.55	37.24±0.56	37.06±0.51	36.90±0.48	36.82±0.58	36.69±0.67

Table (7): Showed the effects of the tested anesthesia up to 90 minutes after injection on **analgesia, sedation and muscle relaxation** (Mean±SD).

Parameters	Group	T 5	T 15	T 30	T 45	T 60	T 75	T 90
Analgesia	I(XGK)	2.60±0.89	2.6± 0.89	2.80±0.89	3.0 ±0.44	3.0 ±0.44	3.0 ±0.54	3.0 ±0.54
	II (XGT)	1.00± 0.0	1.60±0.89	2.00±1.0	3.0 ±1.00	3.0 ±1.00	3.0 ±1.00	3.0 ±1.00
	III(XMK)	2.60 ± 0.8	2.6± 0.89	2.80± 0.0	3.0 ± 0.0	3.0 ± 0.0	3.0 ± 0.0	3.0 ± 0.0
Sedation	(XGK)	3.40±1.3	3.40±1.3	3.6±0.89	3.8±0.89	4.0± 0.4	4.0± 0.6	4.0 ±0.7
	II (XGT)	1.4±3.4	1.6±1.30	3.2±0.44	3.6±0.44	4.0±0.44	4.0±1.3	4.0±1.6
	III(XMK)	3.4 ± 1.3	3.4±1.3	4.0 ± 0.2	4.0 ± 0.3	4.0 ± 0.7	4.0 ± 0.4	4.0 ± 0.5
Muscle relaxation	(XGK)	2.800±1.6	3.4± 1.3	3.40±1.3	3.8±0.44	4.0±0.44	4.0±0.54	4.0±0.54
	II (XGT)	1.2± 1.3	1.80±1.5	3.00±0.44	3.4±0.44	4.0±0.44	4.0±1.3	4.0±1.3
	III(XMK)	3.4 ± 1.3	3.4± 1.3	4.0± 0.0	4.0 ± 0.2	4.0 ± 0.5	4.0 ± 0.3	4.0 ± 0.2

Table (8) : Showed the effects of the tested anesthesia on **induction, recovery scores, time to sternal and time to standing** (Mean±SD).

Groups	Induction	Recovery	Time to sternal	Time to standing
I (XGK)	4.0 ± 0.0	3.2 ± 0.43	22.0 ± 8.9	66.80 ± 9.3
II (XGT)	4.0 ± 0.0	1.83 ± 0.73	45 ± 12.0	95.0 ± 11.8
III (XMK)	4.0 ± 0.0	3.40 ± 0.65	25.0 ± 10.5	65.0 ± 10.5

Table (9): Showed the effects of the tested anesthesia on **blood gases (pao2 and paco2)** (Mean ± SD).

Parameter	Group	Basal	During anesthesia
Pao 2	I (XGK)	111.0±35.04	94.64 ± 34.72
	II (XGT)	108.8 ± 30.68	95.2 ± 20.26
	III (XKM)	151.10± 37.3	102.5± 33.3
Paco 2	I (XGK)	9.06±33.96	44.34 ± 10.82
	II (XGT)	35.06 ± 7.52	47.18 ± 10.62
	III (XKM)	4.151±32.17	44.26± 3.463

Table (10): Showed the effects of the tested anesthesia on **hematology (RBCs, WBCS, Hb and PCV)** (Mean ± SD).

Parameter	Groups	Basal	During anesthesia	After recovery
RBCS	I (XGK)	5.922± 0.433	5.47 ± 0.38	5.42 ± 0.98
	II (XGT)	6.78 ± 0.41	5.41± 0.97	5.97 ± 0.616
	III(XMK)	7.10 ± 1.09	6.46 ± 1.102	6.74 ± 1.41
WBCS	I (XGK)	8. 04± 3. 5	6.5± 3.2	7.8± 4.7
	II (XGT)	13.5 ± 8 .4	11. 2 ± 6. 3	12.7 ± 6.09
	III(XMK)	9.5 ± 2. 05	8.4 ± 1.3	8.9 ± 1.18
Hb	I (XGK)	12.62± 1.7	11.24 ± 1.18	11.96± 1.60
	II (XGT)	15.99 ± 2.24	11.39± 0.72	12.54 ± 1.2
	III(XMK)	14.33 ± 2.6	12.97 ± 2.1	13.49 ± 2.13
PCV	I (XGK)	29.80± 1.9	28.0 ± 2.5	28.40 ± 1.6
	II (XGT)	32.60 ±3.3	26.80± 1.6	28.80 ± 1.09
	III(XMK)	33.80 ± 5.26	31.60 ± 5.2	31.60 ± 6.3

Table (11): Showed the effects of the tested anesthesia after injection on **blood clinical chemistry serum (GOT, GPT, BUN, Creatinine, Glucose, Cortisol, Na and K)** (Mean ± SD).

Parameter	Group	Basal	During anesthesia	After recovery
GOT (IU/l)	I (XGK)	168.3 ± 12.78	163.4 ± 15.7	174.5 ± 9.118
	II (XGT)	180.1± 9.718	168.9 10.15	184.4 ± 12.72
	III (XMK)	169.0 ± 14.18	153.4 ± 10.7	163.4 ± 9.7
GPT (IU/l)	I (XGK)	55.83 ± 6.45	49.13 ± 15.7	65.80 ± 17.2
	II (XGT)	54.73 ± 3.91	44.18 ± 1.57	64.6 ± 815.5
	III (XMK)	59.13 ± 3.45	46.11 ± 9.7	61.80 ± 18.1
BUN (mg/dl)	I (XGK)	32.00 ± 6.73	37.00 ±6.364	34.60 ±6.30
	II (XGT)	40.40 ± 8.081	47.40 ± 9.659	42.00 ± 5.70
	III (XMK)	34.00 ± 3.8	39.00 ± 5.3	35.00 ± 2.9
Creatinine (mg/dl)	I (XGK)	1.160 ± 0.240	1.180 ± 0.151	1.260 ± 0.083
	II (XGT)	1.040 ± 0.2302	1.12 ± 0.249	1.200 ± 0.22
	III (XMK)	0.90 ± 0.11	1.07 ± 0.12	2.1 ± 0.33
Glucose (mg/dl)	I (XGK)	125 0 ± 15.38	142.0 ± 30.3	86.00 ± 33.2
	II (XGT)	98.40 ± 35.85	166.8 ± 48.57	147.0 ± 37.5
	III (XMK)	78.20 ± 15.35	146.2 ± 33.17	137.0 ± 7.5
Cortisol (mg/dl)	I (XGK)	3.0 ± 0.95	3.22 ± 0.97	3.20 ± 0.90
	II (XGT)	2.84 ± 1.2	2.98 ± 1.1	2.80 ± 1.19
	III (XMK)	2.99 ± 0.45	3.5 ± 0.43	3.00 ± 0.50
Na (meq/L)	I (XGK)	167.8 ± 21.1	186.2 ± 20.5	177.0 ± 15.7
	II (XGT)	133.6 ± 18.0	159.0 ± 22.2	163.6 ± 8 849
	III (XMK)	155.8 ± 11.1	196.2 ± 10.5	187.0 ± 12.2
K (meq/L)	I (XGK)	2.266 ± 0.48	2.732 ± 0.36	3.1 ± 0.43
	II (XGT)	2.026 ± 0.329	2.25 ± 0.329	2.58 ± 0.405
	III (XMK)	2.4 ± 0.65	2.7 ± 0.36	3.5 ± 0.43

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الملخص العربى

تقيم بعض نظم التخدير الكلى فى الخيول

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تم إجراء هذه الدراسة على عدد ٣٣ حيوان من أعمار وأوزان مختلفة مقسمة إلى ١٥ حمار للدراسة التجريبية و ١٨ حيوان (٩ حصان و٩ من الحمير) للدراسة الإكلينيكية، تم تقسيمها عشوائياً إلى ثلاث مجموعات.

المجموعة الأولى : تم حقن زيلازين (٥٠٠ مجم)، وجويافنزين (٥٠جم) وكيتامين (٢ جم) فى ١ لتر من محلول دافى من دكستروز ٥٪.

المجموعة الثانية : تم حقن زيلازين (٥٠٠مجم)، وجويافنزين (٥٠ جم) وثيوبنتال (٤جم) فى ١ لتر من محلول دافى من دكستروز ٥٪.

المجموعة الثالثة : تم حقن زيلازين (٥٠٠ مجم)، وميدازولام (٤٠ مجم) وكيتامين (٢ جم) فى ١ لتر من محلول دكستروز ٥٪، تهدئتها مسبقاً بخمس دقائق بالزيلازين بجرعة (١و١مجم/كجم).

تم دراسة تأثير الحقن فى كل المجموعات على كفاءة إحداث التخدير وعدم الشعور بالألم وسكونة وارتخاء العضلات وكفاءة الإفاقة وكفاءة الجهاز الدورى والتنفسى ومكونات وكيمياء الدم وكذلك غازات الدم، أما بالنسبة لكفاءة عدم الشعور بالألم وكفاءة سكون الحيوان وارتخاء العضلات تراوحت بين جيد وممتاز فى حيوانات المجموعة الأولى والثالثة.

بالنسبة لكفاءة إحداث التخدير تميز بحدوثة بشكل سلس فى كل المجموعات المقارنة. أما الإفاقة كانت أطول فى المجموعة الثانية.

يستنتج من هذه الدراسة أن إستخدام أى خليط من الثلاث المختارة فى هذه الدراسة آمن للفصيلة الخيلية.