SUST
Journal of Agricultural and Veterinary Sciences
Journal homepage:
http:// Scientific-journal.sustech.edu

Clinical Evaluation of Continuous Intravenous Infusion of Xylazine and Ketamine for Maintenance of Anaesthesia in Donkeys

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Article history: Received: 3rd January 2016
Accepted: 12th April 2016

Abstract

The aim of this study was to investigate some qualitative and quantitative aspects of total intravenous anaesthesia (TIVA) induced using Xylazine/Ketamine in local donkey breed. Six animals (two females and four males) were used in the study. The anaesthesia was either induced with Xylazine 2mg/kg /ketamine 4mg/kg (XK) or with Xylazine 2mg/kg/ketamine 4mg/kg and maintained with continuous infusion with Xylazine 2mg/kg/Ketamine 6mg/kg in saline drip (XKI). Each animal was anaesthetized with one of the above mentioned protocols with two weeks interval between each successive injection as washing out period. Physiological parameters: respiratory rate, heart rate and rectal temperature were monitored before, during and following induction of anaesthesia. Induction quality, muscle relaxation, phases of anaesthesia and recovery time and quality were also studied. Some blood biochemical values: blood urea, plasma glucose, ALT, and AST activity were measured before and during the effect of the anaesthetic protocols. Results indicated that, heart rate, respiratory rate and rectal temperature were affected significantly ($p \leq 0.05$) at different durations as a result of using each of the two protocols. Both protocols produced smooth to fair induction. Muscle relaxation occurred at variable degrees for different durations of time. Recovery quality produced ranged between smooth, fair to rough quality. Analgesia phase, lateral recumbancy phase and total recovery time were significantly prolonged ($p \leq 0.05$) as a result of using XKI. Glucose level and blood urea concentration were affected significantly ($p \leq 0.05$) as a result of using XKI. Here we conclude that, prolongation of anaesthesia using saline drip infusion containing both xylazine and ketamine would be a suitable alternative for Guaifenesin or top up doses maintenance in donkeys under field conditions.

Keywords: Total intravenous anaesthesia, Xylazine, Ketamine, Donkeys

Abbreviations: GKX= Guaifenesin- Ketamine- Xylazine, XK= Xylazine + Ketamine; XKI=Xylazine + ketamine and infusion with xylazine and ketamine.

Introduction

Anaesthesia was used in animals to provide relief from pain during surgical interference or other procedures likely to cause pain. Safe, effective and reversible anaesthesia requires the selection of a

suitable agent(s), use of appropriate techniques and accurate dosing. Both inhalant and injectable anaesthetics are used in mammals. Inhalant anaesthetics are easier to administer and allow more control of the depth of anaesthesia, but it requires expensive and sophisticated equipment for application. Injectable anaesthetics are often preferred because they can be used without special equipment. A variety of methods can be used for induction of anaesthesia depending on availability of drugs, size and condition of the donkey and familiarity with different protocols (Matthews and van Dijk, 2004). Recent reports indicated that, dissociative drugs such as ketamine could provide other alternatives for routine donkey anaesthetic management (Abakar *et al.*, 2014). The use of xylazine-ketamine for induction and short term anaesthetic maintenance in the horse has been described (Young *et al.*, 1993). Investigators evaluated the behavioural and cardiopulmonary responses associated with varied dose combinations of xylazine and ketamine during anaesthetic maintenance (Mama *et al.*, 1998; Mama *et al.*, 1999a&b).

In the USA the preferred method for induction is to sedate with xylazine (1.1 mg/kg), IV) then to induce anaesthesia with ketamine (2.2 mg/kg, IV). Addition of butorphenol (0.01-0.02 mg/kg, IV) or diazepam (0.03mg/kg, IV) may provide additional sedation and muscle relaxation (Matthews and Van Dijk, 2004). These drugs will generally provide 15-20 minutes of anaesthesia in most donkeys, however, miniature donkeys are inadequately anaesthetized even for a short procedure, with these doses of drugs. They show a lot of muscle rigidity and excitatory effects (Matthews and Van Dijk, 2004).

Although guaifenesin-ketamine-xylazine (GKX) is well documented infusion for total intravenous anaesthesia that has shown good analgesia and muscle relaxant properties (McCarty *et al.*, 1990, Muir, 1991, Young *et al.*, 1993) guaifenesin is unavailable in some countries. Donkeys appear to be more sensitive to guaifenesin, donkeys will become recumbent with approximately 60% of the dose required to produce recumbency in horses (Matthews *et al.*, 1997). Therefore, the choices for total intravenous anaesthesia that do not contain guaifenesin are also limited. Common practice in the field is to induce anaesthesia using ketamine-xylazine combination (a combination that is often used as an induction protocol) and then animals were re-dosed multiple times to prolong the anaesthetic effects (McCarty *et al.*, 1990).

Unfortunately, there are no commercially available pharmaceutical preparations of guaifenesin in Sudan. In addition to that the multiple redosing does not guarantee a constant level of the anaesthetic drug in the blood. The main purpose of this study was to find a comparable alternative (KXI) to GKX for constant rate infusion in locations where guaifenesin was not an option.

Materials and Methods

Experimental animals: A total of six healthy local breed donkeys, four males and two females were used in this study. Their age was 3-5 years with average body weight of 90±15 kg. The animals were kept in closed pens in the College of Veterinary Medicine Farm, Sudan University of Science and Technology throughout the duration of the study. The animals were fed on green fodder, hay and supplemented with concentrates

with free access to water. The animals were kept for two weeks to get acclimatized before starting experiments. Thorough clinical examination was conducted before starting experimental work, after every experiment and routinely throughout the course of the study.

Injection set: disposable syringes 5, 10 and 20 (Nirma limited health care division Sachana Gujarat 382150, India), and intravenous catheters (18 G) were used for intravenous injection of drugs. Normal saline drips and micro-dripper 500 ml/hr was used for infusion.

Drugs: Ketamine was used as the anaesthetic agent in this study together with xylazine as the pre-anaethtic medication as follows:

1. Ketamine Hcl 5% (Troika pharmaceuticals Ltd Thol-382728. Gujarat, India).
2- Xylazine Hcl 2% (Ceva Tiergesundheitb GmbH- Kanzlerstr. 4- 40472. Dusseldorf)

Methods: anaesthetic protocols and methods of injection:

1- Xylazine (2%) 2mg/kg + Ketamine (5%) 4mg/kg. (XK)

2- Xylazine (2%) 2mg/kg + Ketamine (5%) 4mg/kg + infusion (Xylazine 2% 2mg/kg + Ketamine 5% 6 mg/kg). (XKI)

Induction of anaesthesia carried out 10 minutes after injection of the premedication. Anaesthesia was maintained by continuous drip infusion for 20±2 minutes.

Signs and observations following injection of the premedication and/or anaesthetic: following injection of xylazine animals were monitored for 10 minutes to describe the signs and observations of pre-anaesthetic medication injection.

Criteria for scoring quality of induction, muscle relaxation and recovery: a score for the quality of induction ranging from 1 to 3 was used as follows:

Score	Quality	Character
1	Smooth	Gradual falling to the ground with no paddling and no stiffness of limbs
2	Fair	Gradual falling to the ground with mild paddling and no stiffness of limbs
3	Rough	Gradual falling with vigorous paddling and strong stiffness of limbs

Muscle relaxation: a score card for the quality of muscle relaxation ranging from 1 to 3 was used as follows:

Score	Quality	Character
1	Excellent	Complete relaxation (jaws, neck, abdomen and limbs)
2	Good	Relaxation of neck, abdomen and limbs
3	Poor	Rigidity in muscles of jaws ,neck, abdomen and limbs

Recovery: a score card for the quality of recovery ranging from 1 to 4 was used as follows:

Score	Quality	Character
1	Smooth	Donkey capable of standing at first attempt - mild ataxia
2	Fair	Donkey remained calm and needed two- three attempts to stand - clear ataxia
3	Poor	Donkey remained calm but assisted to stand
4	Very poor	Donkeys excitement during recovery - assisted and supported

Anaesthesia Phases:

Induction of anaesthesia: was considered subjectively as the period during which the animal falling to the ground, showed signs of unconsciousness, respond negatively to painful stimuli (pin brick in flank or scrotum) and paddling and stiffness of limbs stopped.

Analgesia phase: was assessed subjectively as the period during which the animal shows signs of unconsciousness and responds negatively to noxious or painful stimuli, pinprick in the perineal and scrotal region

Lateral recumbency: was considered as the duration of time at which the animal responds positively to painful stimuli, muscles regained their tonicity, and is incapable of adopting sternal position (Ghurashi *et al.*, 2008).

Sternal recumbency: it was considered as the period of time during which the animal could adopt sternal recumbancy without falling to lateral recumbancy and without adopting standing position (Ghurashi *et al*., 2008).

Standing phase: it is the stage at which the animal stood but unable to walk ten steps (Ghurashi *et al*., 2007).

Recovery: the animal was considered to be recovered from anaesthesia when it is capable of supporting itself in standing position and walk for ten steps without falling down (Ghurashi *et al.*, 2008).

Total recovery: total recovery time was considered as the total time calculated from the time of induction of anaesthesia until recovery was attained (Nuha, 2004).

Physiological parameters: respiratory rate (breaths/min), heart rate (beats/min) and rectal temperature (^{o}C) were monitored before starting anaesthetic procedure, 10 minutes after injection of the pre-anaestrheic medication, immediately after induction of anaesthesia, and at 10 minutes interval following induction of anaesthesia, using standard methods (Kelly, 1984)

Blood samples collection and Biochemical analyses: blood samples were collected before injection of the pre-anaesthetic medication and at 30,60and 90 minutes after induction of anaesthesia. Whenever blood sample was collected it is delivered immediately to the laboratory to separate plasma in eppendorf container and kept at -20°C until analysis. Blood urea, Plasma glucose, AST and ALT activity were measured using commercial kit (Vitro Scient-Egypt) according to colorimetric methods described by Fawcett and Scott (1960), Barham and Trinder, (1972), and Reitman and Frankel (1957).

Statistical analysis: T- Test was used to compare data between the different anaesthetic phases, while ANOVA was used to compare data for physiological parameters. GraphPad Prism 5.0 (GraphPad Software) was used to perform these analytical operations. A descriptive statistics value (percentage) was used to compare subjective data i.e. induction, analgesia, muscle relaxation and recovery.

Results

Signs and observations following injection of the premedication and/or anaesthetic: following intravenous injection of Xylazine (2mg/kg) in donkeys, main signs observed were dropping of the head, lowering the lip, abduction of the legs, protruding of the penis, profound ataxia and continuous snoring and rubbing of the upper lip and

gum with the foot or even the ground. Salivation was observed to occur in the whole animals subjected to anaesthesia following induction of anaesthesia with the above mentioned protocols, and it was usually started from induction of anaesthesia until at least the end of analgesia phase. The different protocols used in the study resulted in frequent urination by the animals under investigation. Each animal did urinate at least three times during the time of anaesthesia started from induction of anaesthesia until full recovery was attained.

Induction quality: as elaborated in Table (1) induction quality in XK anaesthetized group ranged from smooth to fair induction in 33.3% and 66.7% of the animals used in the study, respectively. While induction and maintenance of anaesthesia using XKI resulted in smooth to fair induction in 66.7% and 33.3% of the animals used in the study, respectively.

Table 1: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on induction quality

Scale	Smooth		Fair		Rough		Total No. of Animals
Protocol	Animals		Animals		Animals		
	No.	%	No.	%	No.	%	
XK	2	33.3%	4	66.7%	0	-	6
XKI	4	66.7%	2	33.3%	0	-	6

Muscle relaxation: as we could observe in Table (2) XK caused muscle relaxation for 20 minutes only, while XKI resulted in muscle relaxation which lasted for more than 40 minutes. The degree of muscle relaxation was found to be variable with time in the two protocols used.

Table 2: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on muscle relaxation

Time	0			10			20			30			40			50		
	Animals			Animals			Animals			Animals			Animals			Animals		
Scale	P	G	E	P	G	E	P	G	E	P	G	E	P	G	E	P	G	E
XK	1	5	0	3	3	0	6	0	0	6	0	0	6	0	0	6	0	0
XKI	1	4	1	0	5	1	0	5	1	0	5	0	1	5	0	6	0	0

P= poor, G= good, E = excellent

Recovery quality: induction of anaesthesia using XK and induction and maintenance using XKI (Table 3) resulted in smooth recovery in 33.3% and 16.6%, fair recovery in 33.3% and 16.6% and poor recovery in 33.3% and 66.6%, respectively.

Table 3: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on recovery quality

Scale	Smooth		Fair		Poor		Very poor		Total No. of Animals
Protocol	No.	%	No.	%	No.	%	No.	%	
XK	2	33.3%	2	33.3%	2	33.3%	0	-	6
XKI	1	16.6%	1	16.6%	4	66.6%	0	-	6

Anaesthetic phase: maintenance of anaesthesia in the second protocol (XKI) resulted in significant increase ($p \leq 0.05$) in the duration of analgesia phase, lateral recumbancy phase and total recovery time when compared to the duration of the same phases observed following induction of anaesthesia using XK . Sternal recumbacy phase standing and walking time were found to be of no significant difference between protocols tested (Table 4)

Table 4: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on different phases of anaesthesia

Phase	Analgesia	Lateral recumbancy	Sternal recumbancy	Standing and walking	Total recovery time
XK	9.00±1.54 a	24.17±10.55 a	9.33±6.22a	2.17±1.17a	37.33±8.38 a
XKI	39.00±8.00 b	47.00±9.30 b	14.17±5.46a	4.83±3.25a	66.83±14.55b

-Different letters on the same column indicate significant difference ($p \leq 0.05$)
- Time in minutes

Physiological parameters:
In XK anaesthetized group a significant ($p<0.05$) drop in respiratory rate was observed 10 minutes following injection of xylazine, and immediately, following induction of anaesthesia and at 10 and 20 minutes after induction of anaesthesia as shown in Figure (1). Animals anaesthetized with XKI expressed a noticeable non significant drop in the respiratory rate 10 minutes after injection of xylazine. Also non significant drop in the respiratory rate resulted immediately after induction of anaesthesia, while a significant decrease ($p \leq 0.05$) was observed at 10 minutes following induction of anaesthesia when compared with the baseline values.

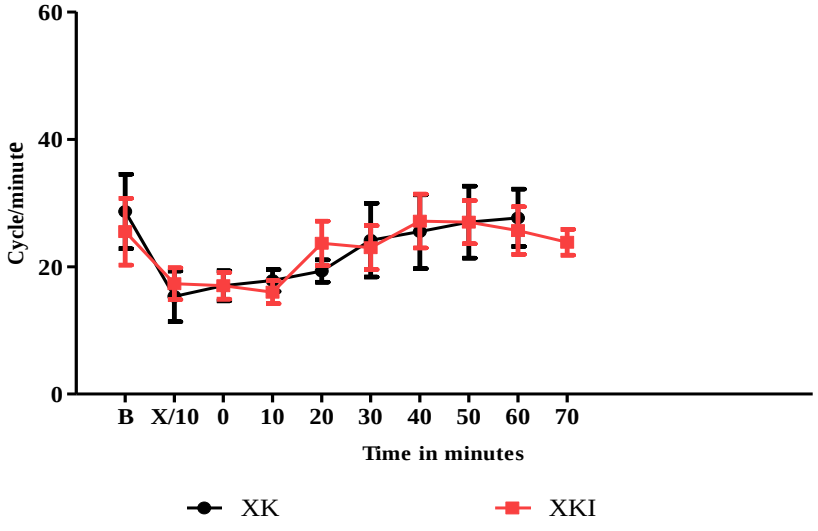

Figure 1: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on respiratory rate

As elaborated in Figure (2) induction of anaesthesia using XK and induction and maintenance using XKI induced slight drop in heart rate 10 minutes after injection of Xylazine and a noticeable but non significant increase in the heart rate immediately after induction of anaesthesia.

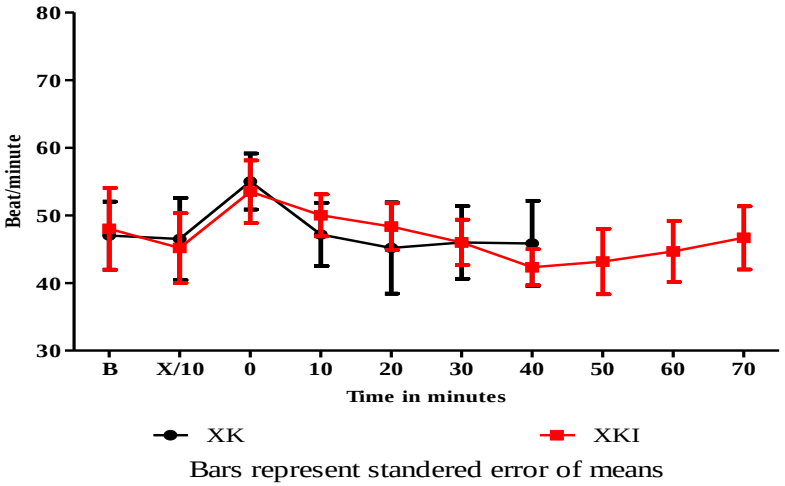

Figure 2: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on heart rate

As observed in Figure (3) usage of xylazine as pre-anaesthetic medication resulted in a significant drop ($p \leq 0.05$) in rectal temperature 10 minutes after its injection in both cases where it was used. The drop in rectal temperature caused by xylazine was observed also after immediately induction of anaesthesia with XK. Induction and maintenance of anaesthesia using XKI caused the significant drop in rectal temperature induced by xylazine to be continued at significantly decreased level ($p \leq 0.05$) until 60 minutes following induction of anaesthesia.

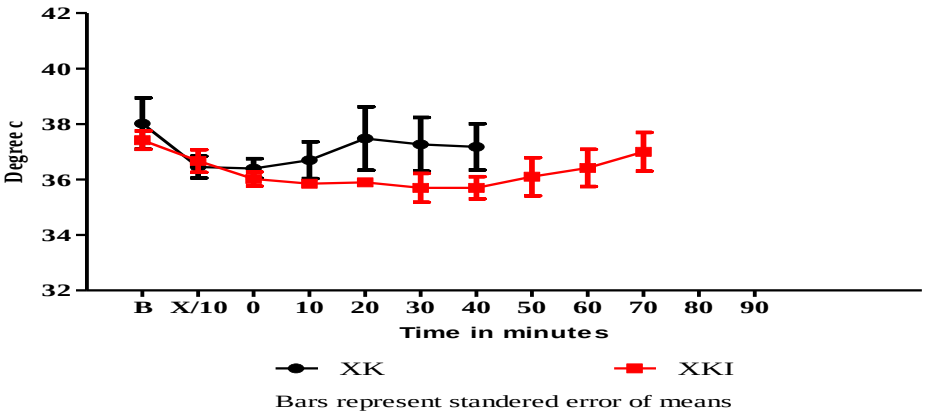

Figure 3: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on rectal temperature

Biochemical parameters: as illustrated in Table (5), induction of anaesthesia with XK resulted in no significant change in blood urea level, AST and ALT activity. While a significant increase ($p \leq 0.05$) in plasma glucose

level was observed at 30, 60 and 90 minutes following induction of anaesthesia with XK when compared with that of baseline value. Maintenance of anaesthesia with XKI resulted in a significant increase ($p \leq 0.05$) in serum urea and glucose concentration at 30, 60 and 90 minutes after induction and maintenance of anaestheis. While AST and ALT showed no significant change when compared with baseline values.

Table 5: Effect of induction of anaesthesia with XK and induction and maintenance of anaesthesia with XKI on Some blood biochemical constituents

Parameters	Time (min)	Base	30	60	90
Urea	XK	2.71±0.40	3.60±1.71	3.99±1.39	4.13±1.33
(mmol/l)	XKI	2.73±0.17a	5.06±0.68b	4.51±0.59b	4.34±0.35b
Glucose	XK	2.96 ±0.59 a	5.97±0.97 b	6.81±1.15 b	6.92±1.53 b
(mmol/l)	XKI	3.61±1.09 a	7.18±0.913 b	5.94±1.74 bc	5.88±1.01c
AST(UI)	XK	80.54±21.16	80.21±25.46	82.86±22.14	83.90±27.50
	X KI	104.0±50.80	96.35±44.80	77.32±17.17	78.53±21.19
ALT(UI)	XK	4.32±0.48	5.12±1.76	4.65±0.83	5.12±2.07
	XKI	7.68±2.45	7.10±3.82 a	8.25±3.20	7.79±2.49

- Different letters in the same raw indicate significant difference ($p \leq 0.05$) between XK and XKI

Discussion

Following intravenous injection of Xylazine 2mg/kg in donkeys, the main signs observed were dropping of the head, lowering of the lip, abduction of the legs, protruding of the penis, profound ataxia and continuous snoring and rubbing of the upper lip and gum with the foot or even the ground. Same observations were reported by Abakar *et al.*, (2014) following intravenous injection of xylazine 1.1 mg/kg in donkeys. Initial apprehension followed by lowering of the head, drooping of the eyelids and lower lip and the horse becomes rapidly ataxic (McCrackin *et al.*, 1994). In goats, intramuscular injection of xylazine, resulted in lowering of head and neck, partial drooping of eyelids, muscular in-coordination and staggering gait (Saleh, 1993).

The frequent urination observed in the current study is in agreement with that reported by White (2006) who indicated that the use of α2-adrenoceptor agonists (xylazine-detomidine) is characterized by bradycardia and an increase in urine production.

The technique of TIVA using mixture of guaifenesin, ketamine and xylazine has been used and promoted for several decades as a method of producing equine anaesthesia. Our data indicate that using each of the two protocols resulted in induction quality which was found to be either smooth or fair which are considered to be safe and acceptable quality of induction because they are free from excitement with gradual falling to the ground with minimal paddling of limbs and no muscle stiffness. Abakar and his colleagues (2014) reported satisfactory quality of induction of anaesthesia following intravenous injection of xylazine, diazepam and ketamine in donkeys. Ketamine produces no muscle relaxation and tonic clonic spasms of limb muscles may occur even in the absence of surgical or other stimulation (Hall *et al.*, 2001). Hence the muscle relaxation observed to occur in this study may be due to xylazine muscle relaxaning effect induced by inhibition of the transmission of neural

impulses in the central nervous system (Delehant *et al*., 2003). Most of the animals anaesthetized with XK showed smooth to fair recovery while fair to poor recovery was the dominant scale observed as a result of using XKI and this may be attributed to the increase of the dose where the dose of the second protocol is double the dose in the first protocol, this finding is supported by Hall and Clarke, (1991) and Elise and Hunter, (1979) who reported the dose dependent effect of xylazine and ketamine.

The significant prolongation in the duration of analgesia, lateral recumbancy and total recovery could be attributed mainly to the increase of the dose of the major anaesthetic and to the increase in the dose of the pre-anaesthetic medication; bearing in mind that the effect of ketamine and xylazine are affected both in magnitude and duration by the dose (Hall *et al.*, 2001)

Anaesthesia with either XK or XKI resulted in a significant decrease in respiratory rate for different durations of time. A result that is considered in the same line with that obtained by other researchers (Khan *et al*., 2004, Bader and AL-kattan 2010 and Seo *et al*., 2011), who reported drop in respiration as a result of using xylazine, since ketamine has no depressive effect on respiratory rate or even some time might have stimulatory effect (Tokics *et al*., 1987, Morse *et al.*, 2004; Von Ungern--Sternberg *et al.*, 2007). Ketamine has different effects on heart rate; no significant effect was reported by Ali (2013) and Abakar *et al*., (2014), stimulatory effect was reported by (Haskins *et al*., 1985, Brady and Koritnik, 1985). Cardiogenic effect of xylazine was reported by Booth, (1988), Seo *et al.*, (2011). In this study the combination of xylazine ketamine lead to no significant effect on heart rate, bearing in mind the stimulatory effect of ketamine and depressive effect of xylazine on heart rate there might be some sort of physiological antagonism between the two drugs which translated in term of no significant effect of the combination on the heart rate. The noticeable non significant increase in heart rate after induction may be attributed partially to the high dose of ketamine and partially to the excitement which may occur during induction of anaesthesia. The significant decrease in rectal temperature following induction and maintenance of anaesthesia with the two protocols is in line with the finding of Mogoa (1997), who reported significant hypothermic effect of ketamine/xylazine combination in donkeys. Also our finding is supported by the observations of Afshar *et al*., (2005) who used the combination in goats; Albozachri *et al*., (2012), who used ketamine xylazine combination with either tramadol or diazepam in donkeys.

In this investigation blood glucose was found to be significantly elevated above the base line values in the two protocols used. Ketamine was reported to have no direct effect on glucose profile (Brady and Koritnik, 1985). So the increase in glucose level observed in this study may be attributed to the effect of xylazine and this finding is supported by the findings of other researchers (Ismail *et al*., 2010, Çamkrten *et al*., 2013, Kullmann *et al*., 2014, and Okwudili, *et al*., 2014) when used Xylazine in combination with ketamine. Using the combination of Xylazine and ketamine in this study reflected contradictory results concerning urea level. The first protocol

XK resulted in a no significant change in urea which is supported by the findings of Camekrten *et al*., (2013), while the protocol of XKI lead to a significant increase in urea level which supported by the finding of Ünsürenl *et al*., (1986) and Okwudili *et al*., (2014). The different effects of the two protocols observed in this study may be due to the dose, where the dose of the components of the second protocol is double the dose of the first protocol, the high dose may interfere with functions of the kidney.

Both protocols XK and XKI have no significant effect on AST activity, this finding is supported by the findings of El-Kammar and Gad, (2014) who used ketamine detomidine combination. Also our finding is supported by the findings of Ismail *et al*., (2010) Camekrten *et al.*, (2013). ALT level was found to be non significantly affected, this finding is supported by the results obtained by El-Kammar and Gad, (2014) and Amin *et al.*, (2012) who used ketamine combinations with other drugs in donkeys. Also our finding is supported by the findings of Camekrten et *al.*, (2013), who used ketamine xylazine combination in Greyhounds.

Conclusion and recommendations

Results obtained in the current study using XK and XKI provided general anaesthesia that is considered safe with minimal changes in cardiopulmonary function. The quality of induction, muscle relaxation, and recovery were acceptable in donkeys. Further studies are required to evaluate effectiveness of such protocol for performing surgical operations.

Acknowledgements

This work was partially supported by a grant from the Scientific Research Deanship, Sudan University of Science and Technology to H.I. Seri. Due thanks are extended to animal attendant Mr. Bakheit Nugd Allah.

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التقويم السريري لمواصلة التخدير في الحمير من خلال التسريب المستمر عن طريق الوريد

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المستخلص:

هدفت هذه الدراسة الي استقصاء بعض الجوانب الكمية و النوعية للتخدير الكلي عن طريق الوريد المحدث بواسطة الزيلازين و الكيتامين في الحمير المحلية. تم استخدام ست من الحيوانات (اثنين من الاناث و اربعة من الذكور) في هذه الدراسة. تم احداث التخدير اما بواسطة الزيلازين 2 مجم/كجم و الكيتامين 4 مجم/كجم (XK) او باستخدام الزيلازين 2 مجم/كجم و الكيتامين 4 مجم/كجم و مواصلة التخدير بواسطة التسريب الوريدي المستمر للزيلازين 2 مجم/كجم و الكيتامين 6 مجم/كجم في محلول وريدي ملحي (XKI). كل حيوان تم حقنه بكلا البروتوكولين بفاصل زمني قدره اسبوعين كفترة زمنية لازمة لازاحة الدواء من الجسم. تم قياس بعض المعالم التي تتعلق بوظائف الأعضاء مثل التنفس ومعدل ضربات القلب ودرجة حرارة الجسم قبل و اثناء و عقب احداث التخدير. كذلك تمت دراسة الآثار التخديدرية للبروتوكولات المختلفة مثل إحداث التخدير وإرتخاء العضلات و اطوار التخدير المختلفة والإفاقة من التخدير. أثناء الدراسة تم كذلك قياس بعض المعالم التي تتعلق بكيميائية الدم مثل معدل اليوريا والجلكوز و إنزيم أسبارتيت امابنوترافيريس وانزيم الانين امابنوترانفيريس والتي تم قياسها قبل وأثناء فترة التخدير. النتائج اشارت الي أن معدل ضربات القلب و درجة حرارة الجسم ومعدلات التنفس الناتجة من إستخدام البروتوكولين أظهرت إنخفاضا معنويا لمستويات وفترات متفاوته عند مقارنتها مع المعدلات الأساسية قبل احداث التخدير. جودة إحداث التخدير تراوح بيت السلس والمعتدل في كل البروتوكولين. ارتخاء العضلات حدث و بدرجات متفاوتة لفترات عديدة. الإفاقة من أثر التخدير بواسطة البروتوكولين المذكورين تراوحت بين السلاسة والإعتدال والفقر. طور فقدان الإحساس بالألم وطور الإستلقاء الجانبي وفترة الإفاقة الكلية الناتجة من إستخدام بروتوكول الزايلازين والكيتامين مع التسريب الوريدي أظهرت فروقات معنوية عند مقارنتها مع تلك الناتجة من إستخدام البروتوكول المكون من الزايلازين والكيتامين فقط. إستخدام بروتوكول الزايلازين والكيتامين مع التسريب الوريدي أدى إلى حدوث إرتفاع معنوي في معدلات الجلكوز و اليوريا بالدم. توصلت الدراسة إلى أن مواصلة التخدير باستخدام التسريب الوريدي في محلول ملحي بحتوي علي كل من الزيلازين و الكيتامين يمكن ان يكون بديلا مناسبا للجوايفينيزين أو للجرعات المتعددة لمواصلة التخدير في الحمير تحت الظروف الحقلية.