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SOME ANAESTHETIC AND PHYSIOLOGICAL EFFECTS OF THIOPENTONE SODIUM

IN GOAT KIDS

(With 5 Tables)

By

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**دراسة بعض الآثار التخديرية والفسيوولوجية لعقار الثايوبنتون صوديوم
في سخلان الماعز**

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تم إجراء هذا البحث علي عدد ٦ من سخلان الماعز المهجنة السليمة وذلك لدراسة الآثار التخديرية والفسيوولوجية لعقار ثيوبنتون الصوديوم و الذي تم استخدامه بجرعة مقدارها ١٠ مجم/كجم وريدياً في الحيوانات المعالجة علاجاً تمهيدياً بواسطة الاسيبرومازين أو الديازيبام أو الزايلازين أو تلك التي لم تعطي علاج تمهيدي. استخدام العلاج التمهيدي أدى إلي تحسين إحداث التخدير مقارنة مع إحداث التخدير من غير استخدام العلاج التمهيدي. توقف التنفس كان علامة مميزة لإحداث التخدير بواسطة هذا العقار في كل الحيوانات تحت التجربة مع ملاحظة حدوث زيادة معنوية في طول فترة توقف التنفس عند استخدام ثيوبنتون الصوديوم مع الزايلازين. معدل التنفس ودرجة الحرارة ومعدل ضربات القلب تأثرت بدرجات متفاوتة. استخدام العلاج التمهيدي خاصة الزايلازين أدى إلي تحسين الآثار التخديرية لعقار ثيوبنتون الصوديوم.

SUMMARY

A total of six healthy goat kids were used in this investigation to study some physiological and anaesthetic effects of Thiopentone sodium at doe level of 10 mg/kg i/v in animals premedicated with acepromazine or diazepam or xylazine and non premedicated animals. Usages of

premedication lead to smoother induction of anaesthesia rather than non premedicated animals. Apnoea occurred in the different groups used in this study with significant prolongation in the group anaesthetized with Thiopentone sodium with Xylazine. Respiratory rate, heart rate and rectal temperature were affected to different limits. Usage of the three different premedication drugs especially Xylazine hydrochloride lead to improvement of Thiopentone sodium anaesthetic effects.

Key words: *Thiopentone sodium, Xylazine, Acepromazine, Diazepam, goat kids*

INTRODUCTION

The importance of goats in many developing countries can be seen in their vital contribution in the production of meat, milk and fresh skin (Payne, 1994). In the Sudan the total population of goats is about 37.346 million head (SBAR, 2000) and they participate efficiently in the national income.

It has been established for many years that all surgical procedures are better be done under inhalation anaesthesia (Hall *et al.*, 2006), should the facilities for it are available. However, the lack of such sophisticated and expensive inhalation machines particularly in the third world countries made the use of intravenous agents coupled with different pre-anaesthetic medications one of the few available options for short to medium term surgery. Being an ultra –short acting barbiturate, Thiopentone sodium, is a good induction agent producing anaesthesia for a very short duration (Hall and Clark, 1982; Singh and Kumar, 1988; and Batoul, 1990).

The aim of this study is to investigate some physiological and anaesthetic effects of Thiopentone Sodium at dose level of 10 mg/kg in goat kids and also to make an attempt to promote the anaesthetic effects through premedication.

MATERIALS and METHODS

Animals

A total of six healthy goat kids, two females and four males were used in this study. They are cross breed between Nubian and Saaneen, five to nine months of age weighing between 12 to 17 kilograms. They were kept in closed pens and fed with roughages and concentrates with free access to water.

Protocols of anaesthesia used:

- 1 - Thiopentone Sodium 10 mg/kg i/v (TH)
- 2 - Thiopentone Sodium 10 mg/kg i/v + Acepromazine (2%) 0.2 mg/kg i/v (TH+ACP)
- 3 - Thiopentone Sodium 10 mg/kg i/v + Diazepam (10%) 0.5 mg/kg i/v (TH +DZ)
- 4 - Thiopentone Sodium 10 mg/kg i/v + Xylazine (2%) 0.1 mg/kg i/v (TH +XY)

Each of the above mentioned protocols was injected in same group of animals at one month interval between each two successive treatments for the purpose of washing out the residues of the drugs.

Premedication

The three pre-anaesthetic medications used in protocol 2, 3 and 4 were injected five minutes prior injection of the anaesthetic drug intravenously.

Monitoring of the physiological and anaesthetic effects

Physiological effects

The respiratory rate, the heart rate and the rectal temperature were monitored using standard methods according to Kelly (1984).

Anaesthetic effects

This study was designed to investigate the following anaesthetic effects:

- 1 - Induction of anaesthesia which include induction time and induction characters. Induction of anaesthesia was determined by unconsciousness and disappearance of reflexes as described by (Jani *et al.*, 1982)
- 2 - Phases of anaesthesia which include:
 - *Anaesthesia phase*: was taken as the time during which the animal is unconscious, no reflexes and responding negatively to the external stimuli (Tamisto *et al.*, 1981), the external stimuli used in this study were assessment of reflexes and/ or pin prick in the flank region.
 - *Basal narcosis phase*: was taken as the duration in which the animal showed signs of unconsciousness but responding positively to external stimuli (Atkinson *et al.*, 1987, Hall and Clark 1982), the external stimuli used in this study were assessment of reflexes and/ or pin prick in the flank region
 - *Lateral recumbancy phase*: was taken as the phase during which the animal opened its eyes and the reflexes were regained but it is unable to adopt Sternal recumbancy position.

- *Sternal recumbancy phase*: was taken as the time elapse during which the animal adopted sternal position but unable to stand.
- *Standing phase*: Was taken as the time during which the animal succeeded to adopt standing position but unable to walk for ten steps without falling.
- *Recovery*: The animal was considered to be recovered from anaesthesia when it was able to support itself in the standing position and walked for ten steps without falling.

Statistical analysis

The raw data of the respiratory rate, heart rate and rectal temperature were analyzed using one way ANOVA and taking the base line value as a control within the same group. The different phases of anaesthesia were compared with each other using one way ANOVA and taking Thiopentone sodium as a control group. The least significant difference was used to determine the significance.

RESULTS

Induction of anaesthesia

The three groups treated with the protocols that contain premedication showed smooth induction, while the non premedicated group showed rough induction which shown by prompt falling of the animal to the ground. The four protocols used in this investigation resulted in non – significantly different durations of induction time (Table1).

Apnoea

Induction of anaesthesia with the protocol of TH + XY resulted in a significantly longer duration ($P \leq 0.05$) of apnoea compared with the other protocols used in this study (Table1)

Respiratory rate

Induction of anaesthesia with Thiopentone resulted in a significant ($P \leq 0.05$) increase in the respiratory rate this increase was observed 20 minutes after induction of anaesthesia.

Following induction of anaesthesia with TH + ACP a significant ($P \leq 0.05$) increase in the respiratory rate was observed immediately after spontaneous respiration was regained (Table 3). A significant decrease in the respiratory rate was observed ten minutes after induction of anaesthesia with TH + DZ (Table 3).

As a result of induction of anaesthesia with TH + XY a significant ($P \leq 0.05$) drop in the respiratory rate was observed

immediately after spontaneous resumption of respiration and at 20 minutes after induction of anaesthesia (Table 3).

Heart rate

Induction of anaesthesia with TH resulted in a significant ($P \leq 0.05$) tachycardia ten min. after induction of anaesthesia, which persisted until full recovery was attained (Table 4).

A significant ($P \leq 0.05$) tachycardia was observed immediately after induction of anaesthesia with TH+ACP and remained at such significantly high levels for 10 and 20 min. after induction of anaesthesia (Table 4).

Usage of TH + DZ as an induction agent resulted in a significant tachycardia at forty and fifty min. after induction of anaesthesia (Table 4).

Induction of anaesthesia with TH + XY resulted in a significant tachycardia immediately after induction of anaesthesia (Table 4).

Rectal temperature

Induction of anaesthesia with the four protocols used in this study resulted in non-significant changes in the rectal temperature (Table 5).

Anaesthetic effects

Anaesthesia phase

Induction of anaesthesia with TH + DZ or TH + XY resulted in anaesthesia phase which was observed to be significantly longer than the anaesthesia phase resulted when TH or TH+ACP were used for induction of anaesthesia (Table 2). Percentage of this phase to the total recovery time was observed to be greater in TH+DZ and TH+XY treated groups when compared to the other two groups (Table 2).

Narcosis phase

Induction of anaesthesia with TH+DZ or TH+XY resulted in narcosis phase which is significantly longer than that occurred when anaesthesia induced with TH or TH +ACP (Table 2), percentage of this phase in TH + DZ or TH +XY treated groups was observed to be greater than that observed in the other groups (Table 2).

Lateral recumbancy phase

Induction of anaesthesia with TH+XY resulted in a significantly longer duration of lateral recumbancy phase when compared with that resulted when anaesthesia was induced with TH or TH+ACP (Table 2), percentage of this phase was observed to be greater than that resulted when anaesthesia was induced with TH and lesser when anaesthesia was induced with TH+DZ (Table 2).

Sternal recumbancy

Induction of anaesthesia with TH resulted in a significantly longer duration of sternal recumbancy phase when compared with TH+ACP or TH+XY treated groups (Table 2).

Standing time

Non-significant changes were observed in the durations and percentages of this phase among the protocols tested (Table 2).

Total recovery time:

Induction of anaesthesia with TH+DZ or TH+XY resulted in total recovery time which significantly longer than that resulted when anaesthesia was induced with TH or TH+ACP (Table 2).

Table 1: Duration of apnoea and induction time in goat kids following administration of thiopentone sodium.

Protocol	Duration of apnoea (seconds)	Induction time (seconds)
TH	10.83 ^a ± 6.67	15 ^a ± 6
TH +ACP	10.83 ^a ± 7.22	17 ^a ± 4
TH+DZ	22.83 ^a ± 14.33	17 ^a ± 5
TH +XY	77.83 ^b ± 25.4	20 ^a ± 8

Different letters in the same column indicate significant difference (P<0.05).

Table 2: Duration and percentage of the different anaesthetic phases in goat kids following administration of thiopentone sodium.

Phase		TH	TH + ACP	TH + DZ	TH + XY
Anaesthesia	Duration	0.85 ^a ± 0.44	3.83 ^{ab} ± 1.77	10.83 ^c ± 3.43	11.16 ^c ± 2.4
	%	4.13	16.35	18.88	25.01
Narcosis	Duration	3.04 ^a ± 3.47	5.05 ^a ± 1.72	19.78 ^b ± 8.79	17.88 ^b ± 5.73
	%	24.52	23.48	37.25	27.00
Lateral Recumbancy	Duration	4.63 ^a ± 0.93	12.25 ^{ab} ± 5.02	18.39 ^b ± 10.12	18.57 ^b ± 3.90
	%	22.53	52.3	34.63	25.69
Sternal Recumbancy	Duration	9.76 ^a ± 6.14	1.43 ^a ± 1.06	3.07 ^a ± 2.98	1.06 ^a ± 1.06
	%	47.49	6.10	5.78	20.43
Standing	Duration	0.27 ^a ± 0.17	0.41 ^a ± 0.29	1.03 ^a ± 0.9	0.02 ^a ± 0.1
	%	1.31	1.75	1.90	1.87
Total Recovery	Duration	20.55 ^a ± 5.46	23.42 ^a ± 5.67	53.1 ^b ± 10.79	50.69 ^b ± 8.59
	%	100	100	100	100

Different letters in the same row indicate significant difference (P ≤ 0.05).

Table 3: Respiratory rate in goat kids following administration of thiopentone sodium.

Protocol	Base	5	0	10	20	30	40	50	60
TH	34.40 ^b ±16.2	21.80 ^a ±7.7	21.85 ^a ±7.7	33.75 ^{ab} ±11.42	58.66 ^b ±8.69				
TH+ACP	45.25 ^{ab} ±14.54	25.62 ^a ±8.12	68.85 ^b ±5.46	29.25 ^a ±7.98	35.75 ^a ±5.93				
TH+DZ	32.37 ^b ±6.81	27.6 ^b ±8.74	21.5a ^b ±9.8	14.25 ^a ±6.19	24.7 ^b ±6.8	28.2 ^b ±10.3	28.8 ^b ±10.1	37.6 ^b ±11.2	40.66 ^b ±11.81
TH+ZY	24.62 ^b ±3.67	20.12 ^b ±2.75	10.12 ^a ±3.82	20.87 ^b ±4.84	9.37 ^a ±3.77	18.75 ^b ±4.65	27.6 ^b ±8.59	30.75 ^b ±9.83	

Different letters in the same row indicate significant difference ($P \leq 0.05$).

Table 4: Heart rate in goat kids following administration of thiopentone sodium.

Protocol	Base	5	0	10	20	30	40	50	60
TH	79.5 ^a ±10	-----	105.75 ^b ±15.31	124 ^b ±19.87	140.33 ^b ±31.3				
TH+ACP	114.3 ^a ±9.82	130.25 ^{ab} ±18.2	148.37 ^b ±14.13	150.75 ^b ±19.63	147.5 ^b ±10.33				
TH+DZ	124.75 ^a ±13.81	121 ^a ±32.44	130.12 ^a ±24.4	131.87 ^a ±24.55	135.37 ^a ±24.65	146.5 ^a ±28.8	160.5 ^b ±13.6	168 ^b ±25.42	129.3 ^a ±12.0
TH+ZY	96.37 ^a ±16.26	77.5 ^a ±18.8	129.37 ^b ±13.03	94.5 ^a ±10.13	97.57 ^a ±6.58	97.5 ^a ±17.3	101.6 ^a ±18.21	98.75 ^a ±18.1	

Different letters in the same row indicate significant difference ($P \leq 0.05$).

Table 5: Rectal temperature in goat kids following administration of thiopentone sodium.

Protocol	Base	5	0	10	20	30	40	50	60
TH	39.6 ^a ± 0.54	39.0 ^a ± 0.54	39.7 ^a ± 0.55	39.6 ^a ± 0.40	39.5 ^a ± 0.35				
TH+ACP	39.81 ^a ± 0.35	40.0 ^a ± 0.36	40.0 ^a ± 0.33	40.0 ^a ± 0.42	40.22 ^a ± 0.22				
TH+DZ	39.85 ^a ± 0.23	39.82 ^a ± 0.18	39.8 ^a ± 0.2	39.75 ^a ± 0.16	39.8 ^a ± 0.26	39.78 ^a ± 0.28	39.8 ^a ± 0.35	40.0 ^a ± 0.6	39.24 ^a ± 0.24
TH+ZY	39.56 ^a ± 0.23	39.6 ^a ± 0.34	39.63 ^a ± 0.31	39.4 ^a ± 0.52	39.28 ^a ± 0.53	39.15 ^a ± 0.59	39.28 ^a ± 0.57	39.17 ^a ± 0.34	

Different letters in the same row indicate significant difference ($P \leq 0.05$).

DISCUSSION

Apnoea is a common character of Thiopentone anaesthesia (Hall *et al.*, 2006), in this study apnoea occurred in all protocols tested and its duration was exaggerated to a significant levels when the protocol of TH + XY was used, this prolongation may be attributed to the effect of Xylazine which was reported to depress the respiratory system (Aithal *et al.*, 1997) while the other pre anaesthetic medications used were known to have minimal effect on the respiratory system (Marntel and Nyman, 1996. Muir and Masonen, 1982), the depressive effect of Xylazine on respiratory centres may potentiate the depressive effect exerted by Thiopentone sodium on respiratory centres hence the significant prolongation of the apnoea duration when this protocols compared with the other protocols used in the study.

The shorter duration of anaesthetic phase resulted from usage of Thiopentone sodium without premedication may be due to the nature of the anaesthetic which classified as an ultra short acting barbiturate which causes a very short period of anaesthesia (Hall *et al.*, 2006)

The significant prolongation of the anaesthesia phase resulted when TH + DZ and TH+XY were used may be due to the effect of the pre anaesthetic medication used which were classified as hypnotic and sedative and their might be some sort of potentiation of the anaesthetic effect of TH as a result of using these two pre-anaesthetic medications the potentiation may be mediated by the depressive effect of the two drugs on the CNS.

XY and DZ are classified as sedative /hypnotic and they lead to excessive depression of CNS more than ACP which is classified as tranquilizer which lead to a CNS depression less than the other two drugs hence the shorter duration of the narcotic and the lateral recumbancy phase caused by the protocol containing the last drug and the protocol containing TH alone.

Sternal recumbancy phase resulted as TH anaesthesia without premedication may be due to the fact that the premedicated animals spent a longer duration in the anaesthesia, narcosis and sternal recumbancy phase and when they reach this phase they passed over it very quickly while in case of TH alone the animal spent a shorter duration of time in the phases preceding this phase so they needed a longer period to pass over this phase.

Induction of anaesthesia with TH with or without premedication resulted in tachycardia (whether it is significant or non significant) at

variable times after induction of anaesthesia; this tachycardia persisted in some protocols for the whole period of anaesthesia and disappeared in some. This result is supported by the findings of Rawling and Kolata (1983), Karimi (1987), and Kumar and Sharma (1986).

Induction of anaesthesia with TH with or without premedication resulted in depression in respiratory rate at different times during the course of anaesthesia and this may be due to the central depressing effect of thiopentone sodium reported by Taylor (1990) in case of TH +XY the late depression effect observed at 20 minutes after induction of anaesthesia may be attributed to usage of xylazine which also reported to cause respiratory depression.

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