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Original Research Article

Propofol Anaesthesia in Pregnant Red Sokoto Goats: An Assessment of Cardiopulmonary and Haematological Parameters

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Abstract

Despite the challenge, some complex surgical interventions will require a general anaesthesia which must be of rapid onset and recovery qualities to minimize the risks. Propofol, a phenolic compound meets the requirement of general anaesthetic agent in ruminants with its rapid onset and recovery properties and minimal effect on the vital and haematological parameters. Propofol has been used without adverse effects on cardiopulmonary and haematological parameters in pregnant goats. Like in other breeds of goat studied, we therefore hypothesized that propofol has no adverse effects or cardiopulmonary system and haematologic parameters and is safe for pregnant Red Sokoto goats. Five (5) healthy pregnant Red Sokoto does (19±0.6kg) were acquired for the purpose of this study and stage of pregnancy was ascertained with the aid B-mode real time transcutaneous ultrasonography. After 14 days of acclimatization, propofol anaesthesia was induced at 4 mg kg^{-1} and maintained at 0.4 $mgkg^{-1}min^{-1}$ continuous infusion rate for 60 minutes. Vital parameters were taken using the standard procedures and blood samples were collected through a pre-placed intravenous catheter at pre-induction period (0 minute) to serve as the baseline and at 5, 10, 15, 30, 45, 60 and 120 minutes during anaesthesia. Statistical analysis showed no significant difference ($P>0.05$) for all the parameters measure except the respiratory rate, MCV and MCH that increased significantly ($P<0.05$) at the 120 minute period of observation. We therefore concluded that propofol is safe for anaesthesia in pregnant RSG with minimal to no effect on vital and haematological parameters.

Keywords: Red Sokoto goat, pregnant, propofol, vital parameters, cardiopulmonary.

INTRODUCTION

Red Sokoto Goat (RSG) like any other breed of goat plays an important role in the food production system in Nigeria, contributes to the economy of the poor people by providing regular source of income and has the most outstanding characteristic of high quality hide and skin. Its high prolificacy and short gestation period make the animal suitable for production among poor and landless livestock farmers [1-3].

Goats undergo many surgical procedures, such as hernia, dystocia, management of traumatic injuries and they need a safe anaesthesia which could be achieved by same drugs used in other species [4]. Local infiltration and epidural anaesthesia supported by physical restraint are commonly carried out in ruminants for diagnostic, obstetrical and surgical procedures [5, 6]. Despite the challenges of general anaesthesia in ruminants, there are however situations whereby a non-cooperating patient is to be managed or complex diagnostic and surgical procedures like management of diaphragmatic hernia and orthopaedics, which will require a general anaesthesia for good prognosis [5, 7-10]. Vieitez *et al.*, 2017 reported a craniotomy for the management of *Coenurus cerebralis*

(gid), which cannot be ordinarily managed by physical restraint and local anaesthesia. In addition, some field anaesthesia, anaesthesia for magnetic resonance imaging and researches will require general anesthesia [11-13]. In recent time as well, goat has been preferred as an animal model in biomedical researchers, surgical training and teaching like in orthopaedics, cardiovascular, respiratory, reproductive and cerebro-vascular studies [8, 14-16]. For ethical reasons therefore, appropriate anaesthetic and analgesic protocols are necessary in this species [11, 15] for complete unconsciousness, improved analgesia, good muscle relaxation, absence of all reflexes and loss of motor ability [5].

Total intravenous anaesthesia (TIVA) is not a common practice in goats, but now gaining a wider acceptance due to the dose-dependent cardiopulmonary depression of inhalant anaesthetic agents if considered for general anaesthesia [13] with lower risk of intra-anaesthetic death [17]. TIVA has added advantage of stable intra-operative autonomic functions, smoother induction and recovery pollution of the working environment is averted [13]. If general anaesthesia is to be used in ruminants, it has to be of rapid onset with rapid recovery to prevent the high risk of regurgitation and tympany these species are predisposed to, hence the use of drug like propofol [18, 19].

Propofol (2,6-diisopropylphenol) is a phenolic compound, non-barbiturate, non-dissociative and non-cummulative intravenous anaesthetic agent [20] with good quality anesthesia, rapid onset, short duration of action and rapid recovery, making the drug potentially useful in ruminants, in which these features are particularly desirable [7, 21-23]. Either administered as intermittent bolus or as continuous infusion, propofol has rapid metabolism and clearance rates in the body system [13, 16, 17]. These properties avert its dose-dependent cardiopulmonary and vital organs depression [13, 19]. It should however be combined with a potent analgesic drug as it does not proffer a substantial analgesia [2, 13]. Propofol could also proffer an antioxidant effect due to its phenolic chemical similarity to vitamin E by reacting with free radicals to generate phenoxy radicals [24, 25].

Successful use of propofol for induction and maintenance of anaesthesia in goats has been reported with relatively stable vital and haematological paramaters [17, 20, 22, 24, 26, 27]. Choice of anaesthetic agent should be done with care pregnant small ruminants so as not to cause reduced placental blood flow and hypoventilation to the dam [28]. The use of propofol in pregnant animals has been reported without adverse effects on the maternal and foetal vital paramaters, uterine blood flow [29] or the spontaneous uterine contraction [30]. Propofol is therefore safer for pregnant animals as compared to other agents, though its less analgesic effect should be making up for [28].

Like in other breeds of goats across the world where the use of propofol has been documented in their pregnant does, we therefore carry out this study to know the cardiopulmonary and haemtological effects of propofol on pregnancy in RSG.

MATERIALS AND METHODS

Five (5) healthy pregnant Red Sokoto does (19±0.6kg) were acquired for this research from a local market in Bodinga Local Government area of Sokoto State and transported to small ruminant pen of Faculty of Veterinary medicine of Usmanu Danfodiyo University, Sokoto. The acquisition was made such that their pregnancy was ascertained to be in second trimester using B-mode real time transcutaneous ultrasonography with 7.0 MHz transcutaneous transducer as described by [31]. They were allowed to acclimatize for 14 days and fed with bean husk, wheat offal and hay twice daily while water was provided *ad libitum.*

Food and water were withdrawn 12 and 6 hours respectively prior to the period of induction of anaesthesia. To have access to the jugular veins, the left side of the neck was clipped around the jugular furrow. The skin was scrubbed using methylated spirit (La Onyz®, Samstella Nigeria Limited, Abule Oba, Nigeria) and 18G intravenous catheters (Beromed GMBH Hospital Product, Berlin, Germany) were placed for the purpose of blood sampling and propofol administration as described by Correia, *et al.*, 1996 and Adetunji, *et al.*, 2002. The anaesthesia was induced with propofol (Pofol®, 1% Dongkook Pharmaceuticals, Korea) at 4 $mgkg^{-1}$ and maintained at 0.4 $mgkg^{-1}min^{-1}$ continuous infusion rate for 60 minutes [34, 35].

Blood sample was collected through the pre-placed catheter before anesthetic induction to serve as the baseline and every 5 minutes for the first 15 minutes and at every 15 minutes afterward till the last 60th minute. The blood sample was also collected one hour after complete recovery. The blood samples collected were placed in a commercial ethylenediamine tetra acetic acid (EDTA) bottle (JRZ Plastilab, Beirut, Lebanon) and were analyzed for complete haemogram within 2 hours of collection full automatic blood cell counter (Erma PCE 210®, Tokyo, Japan).

The base of the tail was clipped and scrubbed for the sensor of pulse oximeter. The heart rate (HR) and respiratory rate (RR) were measured using the pulse oximeter (PC-66®, Devon Medical Products, Jiangsu, China). While the temperature were measured using a digital thermometer per rectum. These were taken at the same time post-induction as stated for the blood sampling.

All the results generated were tabulated and presented as mean±SEM and statistical analysis was done using one-way ANOVA with repeated measure

using GraphPad PRISM 5© for Windows, Version 5.03, 2010. Level of significance was set at P<0.05. The research was approved by the Faculty Animal Research and Ethical Committee.

RESULT

The induction was smooth without any obvious adverse effect on the pregnancy and the experimental animals. The onset was observed to be 34.8±8.7 seconds post-induction. The signs observed include minimal salivation, loss of jaw tone and pedal reflex and prolapse of the third eyelid. The records taken were presented in Figures 1-4 and Table-1.

There were no significant differences in all the parameters measured except the respiratory rate, MCH and MCV, all at the 120th minute.

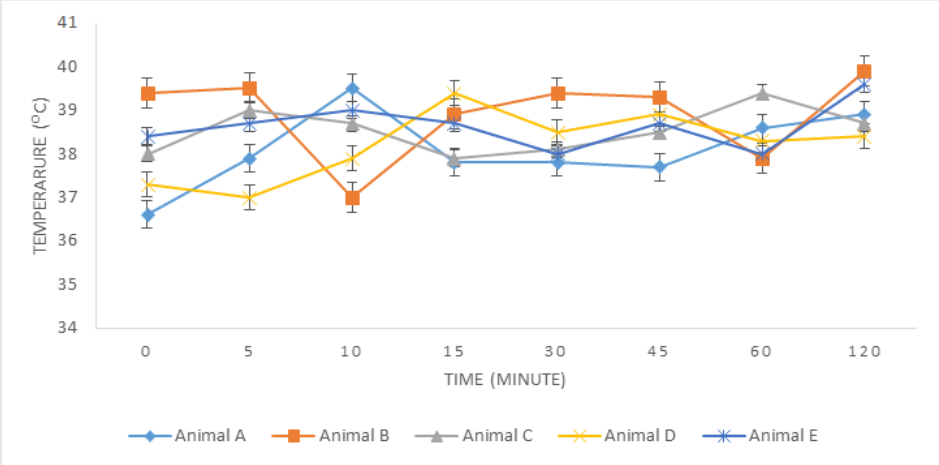

Fig-1: The temperature of the RSG (No significant difference was observed, P>0.05)

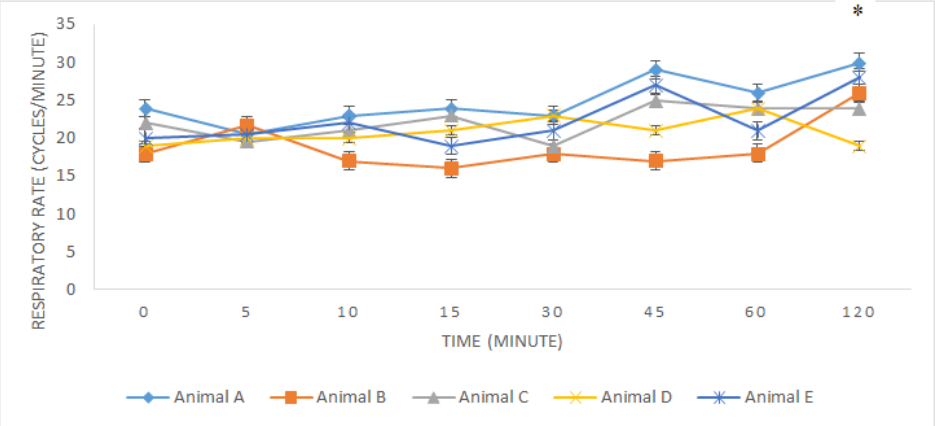

Fig-2: The respiratory rate of the RSG. Significant difference (P<0.05) was observed at the 120th minute when compared to the pre-induction period (baseline)

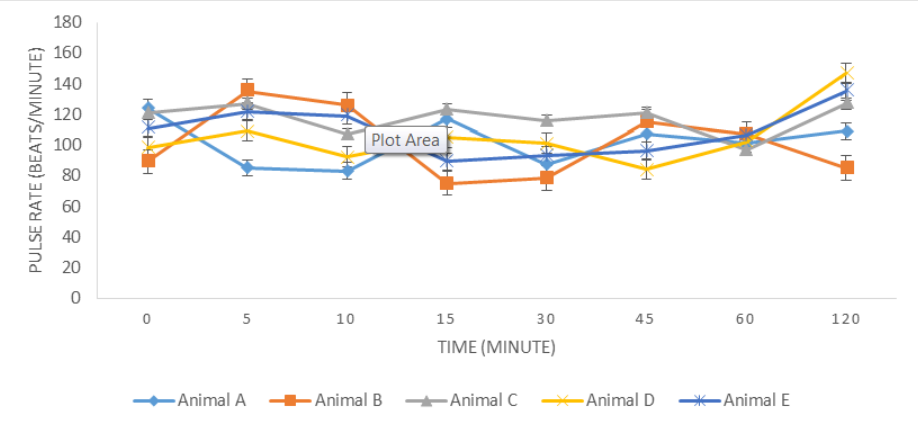

Fig-3: The pulse rate of the RSG. No significant difference (P>0.05) was observed

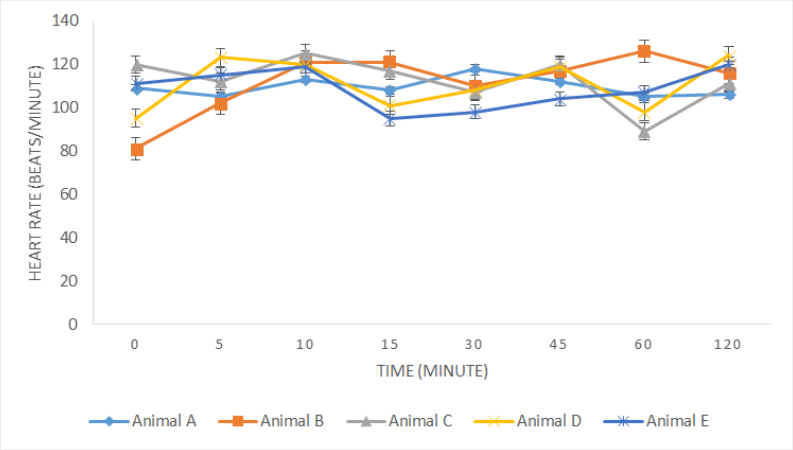

Fig-4: The heart rate of the RSG. No significant difference (P>0.05) was observed

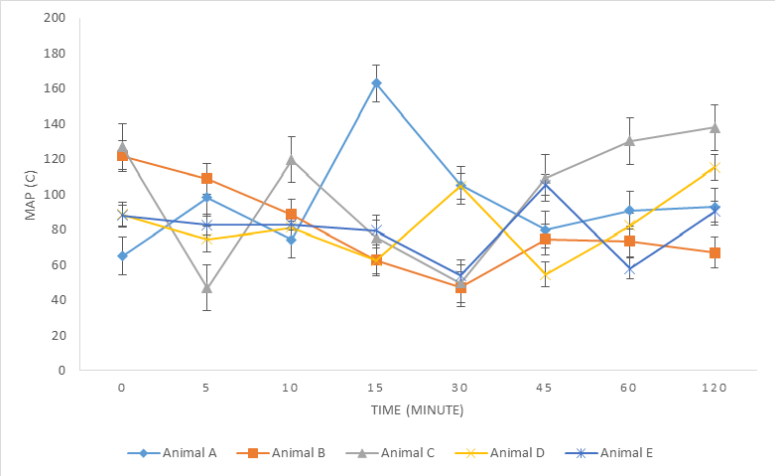

Fig-5: The MAP(C) of the RSG. No significant difference (P>0.05) was observed

Table-1: The haematological parameters (Mean ±SEM) of Red Sokoto does pre- and post-induction of anaesthesia (n = 5)

		Post-induction periods (minute)						
	Pre-induction	5	10	15	30	45	60	120
WBC X 10^9/L	54.08±2.45	51.68±3.27	51.8±3.08	52.34±2.79	52.76±2.49	50.10±3.04	51.46±2.45	52.80±2.52
GranX 10^9/L	15.68±1.27	13.88±1.43	13.08± 1.48	13.60±0.80	12.94±1.73	11.36±1.81	10.88±1.93	11.30±2.51
Lym X 10^9/L	31.74±1.65	37.46±2.19	33.04± 2.11	32.64±1.75	33.28±2.55	34.00±3.54	34.06±3.39	35.90±3.37
Mono X 10^9/L	4.40±0.42	4.12±0.39	3.68±0 .47	4.08±0.17	4.50±0.35	3.42±0.44	4.34±0.44	5.04±1.16
RBC X 10^{12}/L	11.62±0.23	11.44±0.20	11.18±0.27	11.02±0.23	11.20±0.18	11.04±0.22	11.50±0.26	11.34±0.21
HGB (g/dL)	9.50±0.83	8.80±0.74	9.34±0.82	9.24±1.00	9.36±0.98	8.92±0.98	9.40±0.87	9.26±0.96
PCV (%)	20.60±0.60	18.80±1.16	20.80±0.73	20.80±0.58	20.80±0.58	20.80±0.58	21.00±0.71	20.20±0.58
MCV (FL)	16.68±0.53	16.48±0.74	16.48±0.74	16.36±0.71	16.64±0.57	16.36±0.71	15.54±1.28	7.20±0.28[a]
MCH	7.04±0.13	6.90±0.14	7.02±0.18	7.02±0.14	7.02±0.18	7.02±0.18	7.06±0.21	42.52±2.08[a]

Means bearing different a superscript along the same row differ significantly from the pre-induction period (P<0.05). WBC: White blood cell count, Gran: Granulocyte, Lym: lymphocytes, Mono: Monocytes, RBC: Red blood cell count, HGB: Hemoglobin, PCV: packed cell volume, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin

DISCUSSION

Certain complex surgical procedures like diaphragmatic herniorrhaphy, craniotomy, open reduction and internal fixation, tumour excision and many more will require general anaesthesia in ruminants [7, 5, 8, 10, 13]. Aside Caeseren section and other obstertics procedures like embryo transfer that could be carried out under general anaestheia [28], a pregnant goat can as well come down with any other condition that will require general anaesthesia like gid and diaphragmatic hernia. Therefore, the need to study a general anaesthetic drug like propofol that is known

for rapid and smooth induction and recovery as required of a ruminant to reduce the risk of tympany and regurgitation [18, 19].

Propofol has been used successfully in many ruminants including goats [17, 20, 22, 24, 26, 27] and even in pregnant small ruminants [28-30] with stable vital and haematologic parameters. The safety of this agent is then studied in pregnant RSG at second trimester for subsequent usage when the need arises.

Smooth and rapid induction of anaesthesia (34.8±8.7 seconds) was observed in the present study similar to the observations of Dewangan *et al*., and Dzikiti *et al*., Salivation of small quantity was also observed as usual of general anaesthesia in ruminants [36].

The vital parameters measured were rectal temperature, respiratory, heart and pulse rates. All these parameters, except the respiratory rate, did not differ sginificantly when compared with the pre-induction (baseline) period through out the course of 120 minutes of observation. There respiratory rate however increased significantly (25.40±1.89) when compared with the baseline (20.60±1.08). Our findings of non-significant difference in the first 60 minutes of observation of the temperature was in accordance with the study of Kumar *et al.*(2014) on the clinico-physiological effect of propofol and dexmedetomidine in goats. Our observations on heart and respiratory rates differ probably due to dexmedetomidine pre-medication, an alpha-2 agonist which have profound effect on the cardiopulmonary system. Veronica *et al*., also reported a non-significant difference in the rectal temperature and heart rate while there was a significant difference observed in the respiratory rate, which was similar to our findings in the current study. This could be because the respiratory rate could easily increase due to ambient temperature, stress and handling. The values reported by Veronica *et al*., in their study were 108.0±12.5 and 37.9±0.25 as baseline for heart rate and rectal temperature respectively which were similar to our observation (103.2±6.84 and 37.94±0.48 for heart rate and rectal temperature respectively), being the same breed, though different location.

This as well corroborate the fact that propofol did not have any deleterious effect on the vital parameters. The study of Setoyama *et al*., on pregnant Japanese Saanen goats using propofol as induction agent showed just significant increase in the heart rate in the first five minutes and later normalized while other parameters did not differ significantly. Breed responses to certain drugs and geographical location could be responsible for this difference. Some vital parameters that decreased after etorphine and azaperone premedication were normalized upon administration of propofol [37].

Dzkiti *et al*., and Madan, *et al*., also used propofol to induce anaesthesia in Boer and Indian local goats respectively and observed no significant changes. Bodh *et al*., also found out that the vital parameters were maintained in buffalo with propofol anesthesia as compared to thiopentone, which also have the deleterious effect on the foetus after crossing the placenta-blood barrier. In the anaesthetic induction study using buprenorphine-propofol in atropinized goats, Dewangan *et al*., reported a significant decrease in the heart and respiratory rates while the rectal temperature did not differ significantly when compared with the baseline values. The report on the rectal temperature is similar to our study while the difference in the heart and respiratory rates could be as a result of buprenorphine that was co-administered. Okwudili *et al*., also pre-medicated with xylazine before propofol induction in West African Dwarf and observed a decreased vital parameter.

In craniotomy surgery in a goat under propofol TIVA, Vieitez *et al*., reported a stable MAP. In addition, Khattri *et al*., reported a significant decrease in MAP over a period of 75 minutes in uraemic buffalo calves induced with propofol which is in discordance with the findings in the study. The researchers however pre-medicated with dexmedetomidine, which could have caused the decrease observed. In cats, IIkiw and Pascoe, observed a higher MAP in propofol administration as compared to that of isoflurane. This agreed with our findings of non-deletorious effect of propofol on MAP.

Propofol being an ultra-short acting agent has rapid distribution and elimination after bolus injection or constant infusion without cumulative effect [17] and therefore may not have profound haematological effect of blood. Omar *et al.*, observed no significant difference in the value of PCV, Hgb, WBC, RBC, MCH and MCV when propofol anesthesia was compared with ketamine and thiopental in Baghdad local breed of goat in 60 minute observation period as observed in the current study. But there was however, a significant increase in the MCH and MCV at 120 minute of observation. Kumar *et al*., however reported a decreased Hb, PCV and WBC as opposed to the current study. The discrepancy could be as a result of medetomidine pre-medicant which has the potential of pooling the circulating blood cells into the spleen and other reservoirs [17, 40] and the on-going haemorrhage in urolithiasis in the goats observed [17]. The differential white blood count did not differ significantly in the study of Kumar *et al.,* as observed in our study. In agreement with the findings of the current study, Dewangan *et al.*, reported in Indian goats using propofol anaesthesia, non-significant difference in Hb, PCV and total WBC. The non-significant difference in the current study is suggestive of the fact that propofol has minimal effect on haematology.

CONCLUSION

From the current research and earlier findings, it has been observed that without doubt that propofol anaesthesia has minimal effects on both vital and haematological parameters in pregnant RSG. Therefore, propofol can be used in all clinical condition requiring general anaesthesia in pregnant RSG be it obstetrics or other conditions that are to be managed by surgical intervention.

Conflict of Interest: The authors declare no conflict of interest.

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