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Original research

Comparative evaluation of the effect of thiopental, propofol, and ketamine anaesthesia during experimental surgical wound repair in xylazine premedicated local chicken

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ABSTRACT

This study determined the suitable general anaesthetic regimen in local chicken that underwent experimental wound repair by comparing the effect of different anaesthetic protocols. Fifteen healthy matured layer local chickens of average weight of 0.2kg were used for the study. They were randomly assigned into three groups (A–C) of five birds each. Birds in all groups were premedicated with xylazine 2 mg/kg body weight (b/w) IV. Birds in groups A, B and C were anaesthetized with thiopentone, 30 mg/kg (b/w), propofol, 15 mg/kg (b/w) and ketamine, 25 mg/kg (b/w) respectively through the jugular vein. Surgical incisions were made on breast muscle at the depth of 0.1cm and length of 2cm and sutured using size 1 chromic catgut and size 3/0 silk for muscles and skin respectively. The physiological parameters were recorded at 0 min pre induction and subsequently every ten (10) min interval post induction. The anaesthetic indices were also recorded. Data were compared using analysis of variance (ANOVA). The result showed that propofol-xylazine had significantly ($P \leq 0.05$) faster onset, short duration of recumbency, minimal effect on the cardiopulmonary system and on the blood glucose, but provide short surgical anaesthetic time when compared to other drugs. Thiopental-xylazine significantly ($P \leq 0.05$) caused more cardiopulmonary depression compare to Ketamine-xylazine. Ketamine-xylazine had significantly ($P \leq 0.05$) longest onset, duration of recumbency and surgical anaesthetic time with stable cardiopulmonary function among the drugs. Ketamine-xylazine regimen may be considered as the best of the three anaesthetics protocol in local chicken especially during long surgical procedure.

KeyWords: Anaesthetic indices, ketamine, local Chicken, propofol, thiopental, xylazine.

INTRODUCTION

Poultry contributes to a very great extent in the form of meat and eggs for a majority of the population in developing countries. It was estimated that the total meat production was 245 million tons and about 30% thereof was poultry especially exotic breeds of chicken (FAO, 2000). Quite often, local poultry stocks serve as the main source of animal protein to the poor since they are easily accessed by rural households (Umunna *et al*., 2021, Kanyama *et al.*, 2022). There is a growing interest in the use of poultry as a tool in poverty alleviation in the world (Dunya *et al.,* 2015). Poultry production is therefore an effective means of transferring wealth from the high-income urban members of community to the rural dwellers (Dunya *et al.,* 2015, Umunna *et al.*, 2021). It was observed that the native chickens constitute about 80% of the poultry birds in Nigeria (Fayeye and Oketoyin, 2006). Free range chicken production represents an important system for supplying fast growing human population and providing additional income to resource-poor small farmers especially women (Gueye, 2009, Alhassan *et al.,* 2021,). Indigenous chickens have shown to be more disease resistant. Local chicken might be better adapted to survive under harsh conditions without proper management programs and under limited supply of resources. They are known to possess qualities such as ability to hatch on their own, brood and scavenge for major part of their food and possess appreciated immunity from endemic diseases (Ajayi, 2010, Kanyama *et al.*, 2022, Mujyambere *et al.,* 2022).

Most farmers in both rural and urban areas pay less attention to the health and injurious state of local chicken. Local birds are prone to injurious condition due to their free range and people tend to be cruel to them as well as rough handling

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(Ben, 2014, Kperegbeyi *et al.,* 2021). The injurious conditions cannot be overlooked as it may lead to other complications if not taken care of. The injurious conditions such as bone fracture, lacerated wounds, and other conditions like impacted crop and oviduct need urgent surgical intervention.

Surgical interventions can be possible under anaesthesia. Many birds have refractory attitudes towards restraint, sedatives and local anaesthetics which are of little use in most avian species including local chickens (Leslie, 2013, Khamisabadi *et al.,* 2021). General anaesthesia with appropriate agent can enable clinicians to safely and rapidly perform fluid administration, emergency procedures, blood collection and radiography, or perform prolonged invasive surgical procedures because it induces complete unconsciousness, insensitivity to pain, freedom from reflex responses, good muscle relaxation and loss of motor control (Maiti *et al.,* 2006, Leslie, 2013). The use of injectable general anaesthestics is preferred over the inhalation agents because the physiological and anatomical characteristics of birds render the use of inhalant anaesthetics more hazardous in birds than in mammals (Maiti *et al.,* 2006). The injectable general anaesthesia that can be used in birds include ketamine, propofol, thiopentone, ethiomidate etc.

Drug preference among clinicians varies, as well as, many conflicting views with regard to dosage and choice of anaesthetic regime (Leslie, 2013). Therefore, this study is designed to compare the effect of different anaesthetic protocols on local chicken undergoing experimental wound repair with hope to determine the suitable general anaesthetic regimen.

MATERIALS AND METHODS

EXPERIMENTAL ANIMAL.

Fifteen healthy matured local layer chickens of average weight of 0.2kg were used for the study. They were randomly assigned into three groups (A–C) of five birds each. The chickens were fed with commercial feed and water *ad libitum*. They were kept in deep liter in well-ventilated, concrete floor, tin-roofed animal house. The wall of the house was constructed with blocks up to one quarter and the remaining height with wire gauze allowing for light period of 12 hours. All the applicable international, national, and institutional guidelines for the care and use of animals were also followed in this study. Ethical approval was granted by the College of Veterinary Medicine Research Ethics Committee, Michael Okpara University of Agriculture, Umudike, Nigeria (MOUAU/CVM/REC/202223).

DRUGS

The drugs used were ketamine 50mg/mL injection (Laborate pharmaceuticals, India), propofol 10 mg/ml injection, 20mL vial (Popular infusion Ltd, Tongi Bangladesh), thiopentone (Kwality Pharmaceutical Pvt Ltd. India) and xylazine 20mg/mL injection (Kepro Ltd, Holland)

PATIENT PREPARATION

The birds were healthy and were fasted 5 – 8 hours to prevent the presence of ingesta in the crop during surgery. They were weighed using the electronic weighing balance. The birds were restrained by physical manual restraint and were placed in dorsal recumbency on a preparation table. The feathers around the surgical area were plucked off and the area disinfected using mild disinfectant (diluted purit). They were premedicated using xylazine through the jugular vein with 1 ml syringe and 27 G x ½” needle.

ANAESTHETIC PROTOCOL

All drugs were administered intravenously through jugular vein. Group A birds were premedicated with xylazine (2mg/kg body weight) (Varner *et al.*, 2004). Shortly after the administration of xylazine, the birds were anaesthetized using thiopentone (30mg/kg body weight). In a similar way, xylazine (2mg/kg body weight) and propofol (15mg/kg body weight) were administered to birds in group B. Group C birds were also anaesthetized using ketamine (25mg/kg body weight) (Varner *et al.*, 2004), shortly after xylazine administration. Anaesthesia was maintained with the anaesthetics used in each group.

SURGICAL PROCEDURE

The birds were transferred from the preparation table and positioned in dorsal recumbency on the surgical table. The birds were draped, exposing only the surgical site.

An incision was made through the skin on the breast/keel muscle at the depth of 0.1cm and length of 2cm using surgical blade to create a laceration. Sterile gauze was used to control haemorrhage using digital pressure. The muscle was sutured using size 1 chromic catgut and the skin was closed using 3/0 silk. The incision site was covered with plaster and the birds were taken back to the pens following recoveries. Post-operative care and medication were applied.

PHYSIOLOGICAL VARIABLE

The heart rate (HR), respiratory rate (RR), and rectal temperature (RT) were measured at 0min before treatment to ascertain the baseline values and subsequently every ten (10) min interval following the induction till the recovery of each bird with the aids of multi parameter animal monitor (ARI medical equipment Co, Ltd, ARI-800C, Zing, Hong Kong). Manual recording using stethoscope for heart rate and digital thermometer for temperature was also done.

ANAESTHETIC INDICES

Briefly, after treatment, birds of all groups were kept under close observation. Onset of anesthesia, duration of anesthesia or analgesia, duration of recumbency, standing time, recovery period and quality were recorded (Ukwueze et al., 2014)

ONSET OF SURGICAL ANAESTHESIA

The onset of anesthesia was done by recording the time (in min) of the initial injections of the drugs ($t0$) and the time of disappearance of toe-pinch pain reflex (tz). The difference between the times gave the time of onset of surgical anaesthesia.

SURGICAL ANAESTHETIC TIME

The Surgical anaesthetic time was done by noting the time of the onset of the surgical anaesthesia and the time the birds respond to the surgical pain or to the toe-pinch pain reflex after surgery. The difference between the times gave the surgical anaesthetic time

DURATION OF RECUMBENCY

The Duration of Recumbency was measured by recording the time when birds assumed recumbent position following anaesthetic administration and the time when the bird was able to maintain standing position on its own following recovery from anasthesia. The difference between the times gave the duration of recumbency.

STANDING TIME

The standing time was calculated by determining the difference between the time when the bird assumed sterna posture as sign of recovery and when the bird finally stood on its own unassisted.

OBSERVATIONS:

Close monitoring was applied to ascertain respiratory rate and pattern, cardiovascular activity, the nerve responses, and behavioral patterns of the birds under anesthesia.

BLOOD GLUCOSE TEST

The blood sugar level of the bird was determined in the morning before the administration of the anaesthetics (pre-anaesthetic value, 0min), 20, 40 and 60 minutes after induction of the anesthesia. The blood glucose concentrations were measured immediately after blood sample was obtained through wing vein, using a handheld glucose meter (Accu-Chek, Roche Diagnostics, Auckland, New Zealand). It was done by dropping blood sample obtained on a glucose test strip inserted in a Glucometer (ACCU-CHEK active serial number 4MF15 and code F458) which instantly displayed the sugar level on the screen. The values obtained were expressed in mg/dl of the blood.

DATA ANALYSIS.

Data were expressed as mean ± standard error of mean (± SEM) in each group. The means were compared using analysis of variance (ANOVA). The means were separated using least significant difference (LSD). A probability value less than or equal to 0.05 ($P \leq 0.05$) was considered statistical where applicable.

RESULTS

ANAESTHETIC EFFECT

After the induction of anaesthesia, the onset of action of drug in xylazine-propofol group was significantly ($P \leq 0.05$) shorter when compared to xylazine-thiopentone and xylazine-ketamine groups. There was no significance variation ($P > 0.05$) in the onset of action in xylazine-thiopentone and xylazine-ketamine groups.

The surgical anaesthetic time was significantly ($P \leq 0.05$) shorter in xylazine-propofol group when compared to xylazine-thiopentone and xylazine-ketamine groups. It was short in group A when compared to group C. In other words, it is significantly ($P \leq 0.05$) longer in group C than in group A and short in group B.

The duration of recumbency was significantly ($P \leq 0.05$) shorter in group B when compared to group A and C. However, there is no significant variation in duration of recumbency between group A and C.

There is no significant difference in the standing time among the three groups.

PHYSIOLOGICAL EFFECT

HEART RATE

There was no significant ($P > 0.05$) variation in heart rate among the three drugs from 10-20 minutes post induction. However, there was significant ($P \leq 0.05$) increase in heart rate in xylazine-propofol group at 30 minutes post induction when compared to xylazine-thiopentone and xylazine-ketamine groups. The heart rate, however decreased significantly ($P \leq 0.05$) in xylazine-thiopentone group from 30-60minutes post induction when compared to xylazine-propofol and and xylazine-ketamine groups. The significant ($P \leq 0.05$) decrease in heart rate in xylazine-thiopentone group started from 20-60 minutes post induction when compared to the pre-induction values. In contrary, the heart rate increased significantly ($P \leq 0.05$) in group B from 30-60 minutes post-induction when compared to the pre-induction values. There was no significant post-induction variation in heart rate when compared to the pre-induction values in xylazine-ketamine group (figure 3).

RESPIRATORY RATE

There was significant ($P \leq 0.05$) decrease in respiratory rate in groups A and C at 20- and 60-min post induction when compared to group B but, there was no significant ($P > 0.05$) variation in temperature. However, respiratory rate decreased significantly ($P \leq 0.05$) in all the groups from ten to sixty (10-60) minutes when compared to the pre-induction values.

RECTAL TEMPERATURE.

There was no significant ($P > 0.05$) variation in temperature among the three groups of drugs. However, in group A and B, there was significant ($P \leq 0.05$) drop in temperature from 10 to 60 minutes post induction when compared to the baseline. In group C, temperature dropped significantly ($P \leq 0.05$) from 30 – 60 minutes post induction when compared to the baseline (0 min) (figure 1)

Table I: Mean (±SEM) anaesthetic indices following intravenous administration of thiopental, propofol, and ketamine in xylazine premedicated local chicken.

Groups	Onset	Surgical anaesthetic time	Duration of recumbency	Standing time
Thiopentone	2.00±0.35[b]	50.66±9.24[b]	97.00±15.79[b]	15.33±0.55
Propofol	0.67±0.10[a]	15.00±2.39[a]	24.33±3.29[a]	11.00±1.31
Ketamine	1.66±0.21[b]	76.33±7.93[c]	100.00±1.82[b]	17.00±3.18

[abc] values with the superscript within a row are significantly different ($p \leq 0.05$)

Table II: Mean (±SEM) of blood glucose in local chicken following intravenous administration of different anaesthetics combination

Groups	0 min	20 min	40min	60min
Thiopentone	172.60±6.68	154.60±10.87	152.80±13.05	152.20±12.26[a]
Propofol	167.20±15.53	177.40±27.94	178.00±19.76	206.40±26.38[b]
Ketamine	200.00±11.06	198.20±14.38	176.00±12.84*	147.00±12.07*[a]

Data in the same row differ significantly from the preinduction value ($p \leq 0.05$)
[abc]values with different superscript within a column are significantly different ($p \leq 0.05$)

BIOCHEMICAL EFFECTS

BLOOD GLUCOSE LEVEL

There was significant ($P \leq 0.05$) increase in blood glucose level in group B at 60 minutes post induction when compared to the other groups. However, blood glucose decreased significantly ($P \leq 0.05$) in group C from 40-60 minutes post induction when compared to baseline. There was no significant ($P > 0.05$) variation in blood glucose level of groups A and B when compared to the baseline (figure 4).

DISCUSSION

Based on the result for anaesthetic indices, propofol has the fastest onset of action (0.67 ± 0.10) compared with that of ketamine and thiopental; propofol has rapid onset, smooth induction and rapid recovery (Prassinos *et al.,* 2005).

The surgical anaesthetic time (SAT) for propofol was also short. This is in line with the findings of Prassinos *et al.* (2005). According to Micromedex *et al.* (2016), premedicants such as xylazine may not always prolong the surgical anaesthetic time of propofol as the same induction doses of propofol had the same effect in premedicated and unpremedicated animals. This was confirmed in this study as the chickens were premedicated with xylazine prior to propofol induction. The SAT was longer in ketamine than in thiopental. Xylazine-ketamine combination increases the SAT (Gandomani *et al.*, 2011). SAT in thiopental was 50.66 ± 9.24 min for intravenous injection. However, Kumar (2012) and Hemming (2010) reported 10 – 30mins brief duration of action of thiopental. The longer time could be due to the combination with xylazine.

The duration of recumbency was shorter in propofol when compared to ketamine and thiopental. This is as a result of its rapid recovery property (Prassinos *et al.,* 2005; Micromedex *et al.,* 2016). Ketamine and thiopental have similar duration of recumbency pointing to delayed recovery post induction. However, the three drugs Propofol, ketamine and thiopental has similar standing time.

The result of the physiologic variables showed that ketamine, propofol and thiopental all have similar effect on the temperature. That is, they caused mild drop in cloacal temperature (Alison *et al.,* 2014; Lin *et al.,* 1979; Son, 2007). The drop in temperature could be as result of combined effects of the anaesthetics and sedatives on the thermo-regulatory centre (Gandomani *et al.,* 2011).

There was decreased respiratory rate in all the combination of xylazine with the three anaesthetics with a more pronounced decrease in ketamine and thiopental at 20 and 60min post induction. but, minimal respiratory depression with propofol. This is in accordance with the study done by Steinbacher, (2001). The pronounced decrease in respiratory rate with xylazine-ketamine combination is also in agreement with the study done by Gandomani *et al.* (2011) and Uzma *et al.* (2009). Xylazine has a high depressant action on the respiratory system (Uzma *et al,* 2009). Thiopental causes respiratory depression and in combination with xylazine caused a more pronounced decrease in the respiratory rate (Kumar 2012).

There is increased heart rate in propofol and ketamine though the heart rate was irregular among the three anaesthetics. The irregularity could be due to the arrhythmic effect on the heart leading to cardiovascular instability. This is in agreement with the study done by Javdani *et al.* (2011). However, Thiopental caused decreased heart rate when compared to the baseline leading to bradycardia. Thiopental causes cardiovascular depression (Kumar, 2012; Lupton and Pratt, 2008). In contrary, McEnvoy, (2003) reported tachycardia effect of thiopentone in human in his study. It was found that Propofol has irregular but increase heart rate in local chicken from 30 min post induction. The irregularity

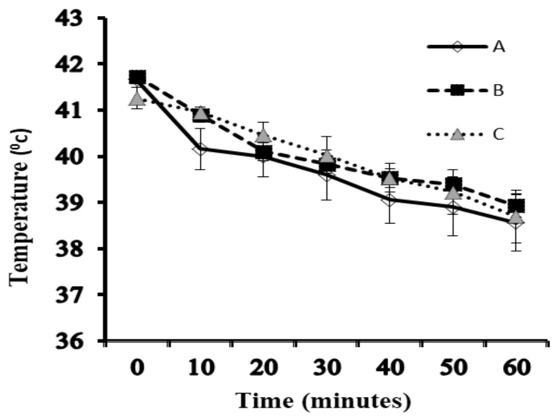

Figure I: Mean (±SEM) temperature following intravenous administration of thiopental (A), propofol (B), and ketamine in xylazine (C) premedicated local chicken

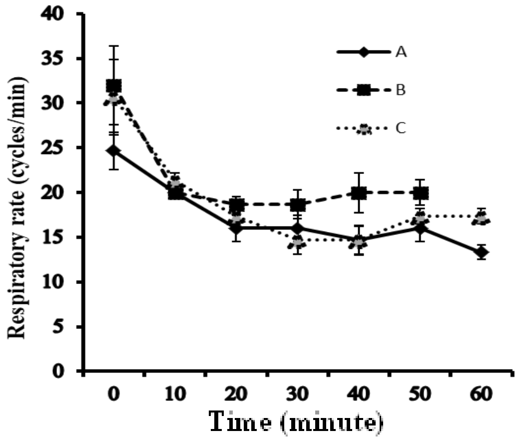

Figure II: Mean (±SEM) respiratory rate following intravenous administration of thiopental (A), propofol (B), and ketamine in xylazine (C) premedicated local chicken

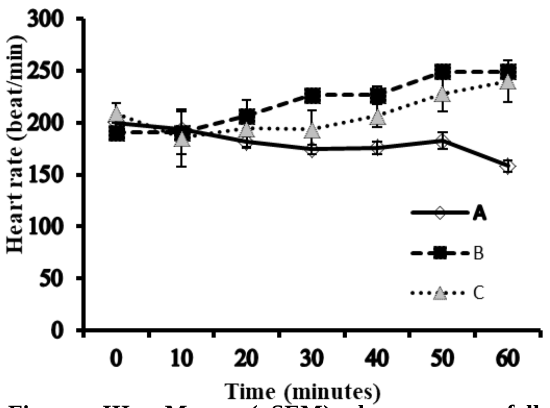

Figure III: Mean (±SEM) heart rate following intravenous administration of thiopental (A), propofol (B), and ketamine in xylazine (C) premedicated local chicken

indicates cardiac arrhythmia (Lukasik *et al.,* 1979). However, cardiopulmonary depression, arrhythmia and significant respiratory depressive effect of propofol in chicken had been reported (Lukasik *et al.,* 1979; Microdex *et al.,]* (2016). At 30 min post induction, birds were almost recovered from the effect of the anesthesia, the increase in heart rate might be a response to hypothensive effect of propofol in some animals (Steinbacher, 2001; Khurana *et al.,* 2014), as the heart was trying to push more blood into the circulation to compensate the drop in the blood pressure thereby increasing the rate of its function. Xylazine has a depressant action on cardiovascular system (Gandomani *et al.,* 2011; Uzma *et al.,* 2009) leading to decrease in heart rate in xylazine-thiopentone group, the combined cardiovascular depressant effect of the two drugs was obvious. However, in xylazine-ketamine group, ketamine may have countered the depressive effect of xylazine on the heart with its stimulatory effect.

In blood glucose level, there was decreased blood glucose level in the ketamine group, but increase in the blood glucose in the propofol group. However, xylazine causes temporal hyperglycemia (Ukwueze *et al.,* 2014; Maiti, 2006; Fayed *et al.,* 1989). The increase in blood glucose in propofol group could be due to the effect of xylazine and it could also be due to the fact that propofol has short duration of action enhancing the effect of xylazine on the blood glucose. Propofol may have minimal effect on the blood glucose but this cannot be concluded as a fact since it was in combination with xylazine. Ketamine decreased the effect on the blood glucose. this could be due to the fact that the effect of xylazine on the blood glucose was countered by ketamine. It may also be a response to energy demand as ketamine stimulates muscular activity (Hsu *et al.,* 2011) In other words, ketamine can induce hypoglycemia in local chicken (Suleiman *et al.,* 2009). Also, preanaesthetic fasting coupled with the effect of ketamine can also induce reduced blood glucose level.

CONCLUSSION

Propofol has the fastest onset, short duration of recumbency, minimal effect on the cardiopulmonary system and on the blood glucose, but its short surgical anaesthetic time may demand for anaesthetic maintenance. Anaesthetic maintenance in chicken is difficult with intraveneous agent. It is therefore not recommended for long surgical procedures but only good for minor or short surgical procedures that may last for maximum of 15 -20min. Thiopental caused cardiopulmonary depression. It also caused trauma, swelling, ulceration and hematoma when wrongly administered extravascularly. So, it is not the best anaesthetic of choice in local chicken.

Ketamine combination has stable cardiovascular system, long surgical anaesthetic time and multiple routes of administration with some side effects. The xylazine-ketamine combination is better anaesthetics protocol in local chicken especially during long surgical procedures.

The results of this research can be extrapolated to other birds, serving as a template especially in prized exotics avian species like peafowl and parrot or in big avian species like ostrich.

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