Cardiopulmonary Effects of Alfaxalone-Xylazine versus Ketamine-Xylazine Anaesthesia in Local Chickens (Gallus gallus domesticus): A Pilot Study

Buluba Robert Sungwa[1], Faraja Hosea Mpagike[2], Felix Kiwale Albert[2], Vedastus Wilfred Makene[3], Donald Gregory Mpanduji[2, 3]

[1]*Zonal Veterinary Centre, P.O. Box 1068, Arusha, Tanzania,*
[2]*Department of Veterinary Surgery and Theriogenology, College of Veterinary Medicine and Biomedical Sciences, Sokoine University of Agriculture, Morogoro, Tanzania,*
[3]*Department of Biological and Food Sciences, The Open University of Tanzania, Dodoma Regional Centre. P.O. Box 1944, Dodoma, Tanzania.*

Correspondence: donald.mpanduji@out.ac.tz

SUMMARY

This study compared the effects of alfaxalone–xylazine and ketamine–xylazine combinations on anaesthesia in local chickens. Ten healthy chickens were randomly allocated into two groups: alfaxalone (5 mg/kg, n=4) or ketamine (5 mg/kg, n=6), both pre-mixed with xylazine (2.5 mg/kg) and administered intravenously via the wing vein. Induction time, duration of anaesthesia, and cardio-pulmonary parameters (respiration, heart rate, cloacal temperature) were monitored. Both protocols induced rapid anaesthesia with significant reductions in respiration and heart rates. Transient apnoea and cyanosis were observed only in the alfaxalone–xylazine group but resolved without mortality. Duration of anaesthesia did not differ significantly between groups (P>0.05). Both protocols appear suitable for inducing anaesthesia in local chickens; however, the small sample size and transient apnoea with alfaxalone-xylazine call for caution. Larger studies with stronger statistical methods are needed before firm clinical recommendations can be made.

Keywords: Alfaxalone, Ketamine, Xylazine, Chicken Anaesthesia, Apnoea

Article History

Submitted: 3 October 2025
Revised: 5 August 2026
Accepted: 18 August 2026
Published: 20 August 2026

Tanzania Veterinary Journal
Vol. 41(2)2026
https://doi.org/10.4314/tvj.v41i2.6
ISSN: 0856 - 1451 (Print)
ISSN: 2714-206X (Online)
https://tvj.sua.ac.tz

INTRODUCTION

In many developing countries, keeping local chickens dominates small to medium scale farms (Mujyambere et al., 2022; Kitalyi, 1998) and serves as an important source of household income (Wilson et al., 2022; Mlozi et al., 2003; Ogali, 2011). Local chickens often develop conditions requiring surgical intervention including but not limited to the following; lacerated wounds, abscesses, feather cysts, lipomas, corneal ulcers, pododermatitis, and osteomyelitis (Button, 2016), Such conditions require anaesthesia for the management since birds do not tolerate prolonged manual restraint (Lawton,1996).

In Tanzania, avian anaesthesia is rarely practiced beyond anecdotal use in pet birds, and no prior studies have evaluated anaesthetic protocols for local chickens. This study aimed to evaluate and compare the effectiveness and cardio-pulmonary effects of two intravenous anaesthetic protocols: alfaxalone-xylazine and ketamine-xylazine.

MATERIALS AND METHODS

Study animals and housing

The study was approved by Sokoine University of Agriculture Research Ethics Committee. Ten apparently healthy local chickens aged between .25-30 weeks were purchased from local markets, vaccinated against Newcastle disease, dewormed, and acclimatized for 14 days on commercial feed at the College of Veterinary Medicine and Biomedical Sciences.

Anaesthetic protocols

Birds were randomly assigned to two groups. Ten chickens were individually identified and numbered from 1 to 10. Chickens numbered 1-4 were assigned to receive the xylazine–ketamine combination, whereas chickens numbered 5-10 received the alfaxalone-ketamine combination. Allocation was based on the predetermined identification numbering system (Table 1). Drug doses were adapted and adjusted from Maskatow et al., 2021; White and Martine-Taboada, 2019 and Maiti et al (2006) and calculated according to body weight (CLSA07, 2017).

Table 1 Doses of alfaxalone, ketamine and xylazine protocols for induction of anaesthesia in local chickens

SN	Pre anaesthetic	Dose	Anaesthetic	Dose	Animal Used
1	Xylazine[1]	2.5 mg/kg	Alfaxalone [2]	5 mg/kg	4
2	Xylazine[1]	2.5 mg/kg	Ketamine[3]	5mg/kg	6

Drug sources: [1]AGRAR Holland BV; [2]Julox Pty NSW, Australia; [3]TRITTAU Germany

The drugs were pre-mixed and administered slowly by intravenous injection (over 60 seconds) into the wing vein using insulin syringes (FAO, 2002). A ketamine dose of 5 mg/kg was selected based on preliminary trials in which higher doses (6-10 mg/kg) were associated with mortality in some chickens. Therefore, the lower dose was adopted and used in the present study.

Monitoring and data collection

Induction time was defined as the interval from injection to loss of consciousness. Duration of anaesthesia was measured from loss of consciousness until recovery of righting reflex. Heart rate, respiratory rate, and cloacal temperature were recorded at 5-minute intervals using a stethoscope and digital thermometer.

Statistical analysis

Data was entered into Microsoft Excel and analyzed using unpaired t-tests. Results were expressed as mean ± standard deviation (SD). Significance was set at $P \leq 0.05$. The study recognize that repeated measurements of heart rate, respiration, and cloacal temperature introduce within-subject correlation, which violates the independence assumption underlying unpaired t-tests. Ideally, repeated-measures ANOVA or mixed-effects modeling would be applied to account for this structure. However, given the very small sample size (n=4 vs. n=6) and the exploratory nature of this study, such models were not statistically reliable. For this reason, the study restricted the analysis to simple unpaired t-tests at individual time points, treating the results as preliminary and descriptive rather than definitive. We emphasize that these findings provide baseline data only and recommend that future studies with larger cohorts employ repeated-measures or mixed-effects approaches to yield more robust and generalizable conclusions. Due to the small sample size, findings should be interpreted cautiously.

RESULTS

Induction and duration of anaesthesia

Both protocols produced smooth induction within 60 seconds. The mean duration of anaesthesia was 40.0±4.1 minutes for alfaxalone-xylazine (Table 2) and 39.7±7.0 minutes for ketamine-xylazine (Table 3). There was no significant difference between groups (P=0.391). All chickens recovered uneventfully.

Table 2. Induction time and duration of anaesthesia in chicken given alfaxalone combined with xylazine (n=4)

Anaesthesia parameters monitored	**Animals**				**Mean ± SD**
	1	**2**	**3**	**4**	
Induction time(seconds)	30	30	35	29	
Recovery time(minutes)	40	40	46	36	
Duration of anaesthesia (Minutes)	40	40	46	36	**40±4.12^{ns}**

Note: ns= Denotes statistically non-significant between groups, SD=Standard deviation.

Table 3. Induction time and duration of anaesthesia in chicken given ketamine combined with xylazine (n=6)

Anaesthesia parameter monitored	**Animals**						**Mean ± SD**
	1	**2**	**3**	**4**	**5**	**6**	
Induction time(seconds)	30	30	37	40	30	26	
Recovery time(minutes)	40	43	39	34	43	30	
Duration of anaesthesia (minutes)	40	43	39	43	43	30	**39±7.04^{ns}**

Note: ns= Denotes statistically non-significant between groups, SD=Standard deviation.

Respiratory effects

Both protocols caused a marked reduction in respiratory rate (Figure 1). Alfaxalone-xylazine induced t which resolved spontaneously. Ketamine-xylazine produced bradypnoea but no apnoea. Respiration was found to differ significantly within groups while no differences were observed between alfaxalone and ketamine treated groups for the entire observation period.

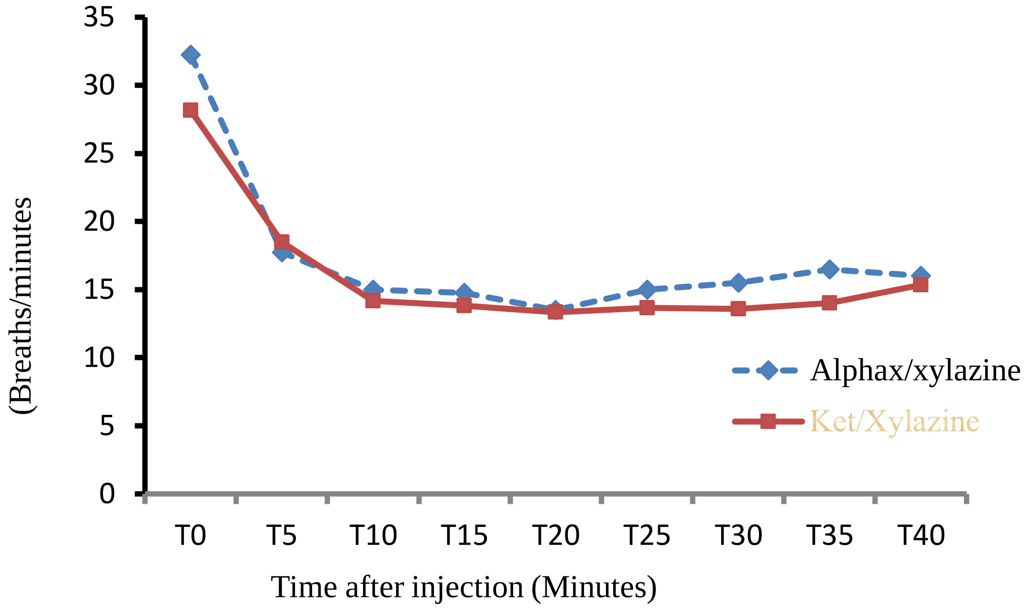

Figure 1: Effect of alfaxalone /xylazine (n=4) and ketamine/xylazine combination (n=6) on respiration rates on chicken

Heart rate

Both protocols significantly reduced heart rate within 5 minutes of induction (Figure 2), with no difference between groups (P=0.512). The reduction was sustained throughout the observation period. Xylazine (2.5mg/kg)-alfaxalone (5mg/kg) combination resulted in a shrunk and flabby comb whose colour changed from pinkish to bluish (Figure 3) within 10 seconds. Xylazine (2.5mg/kg) and ketamine (5mg/kg) induction did not appear to induce such effect.

Cloacal temperature

Cloacal temperature declined progressively in both groups. In ketamine–xylazine group, temperature gradually decreased until recovery. In alfaxalone-xylazine group, temperature fluctuated during anaesthesia. No significant differences were observed between groups (Figure 4).

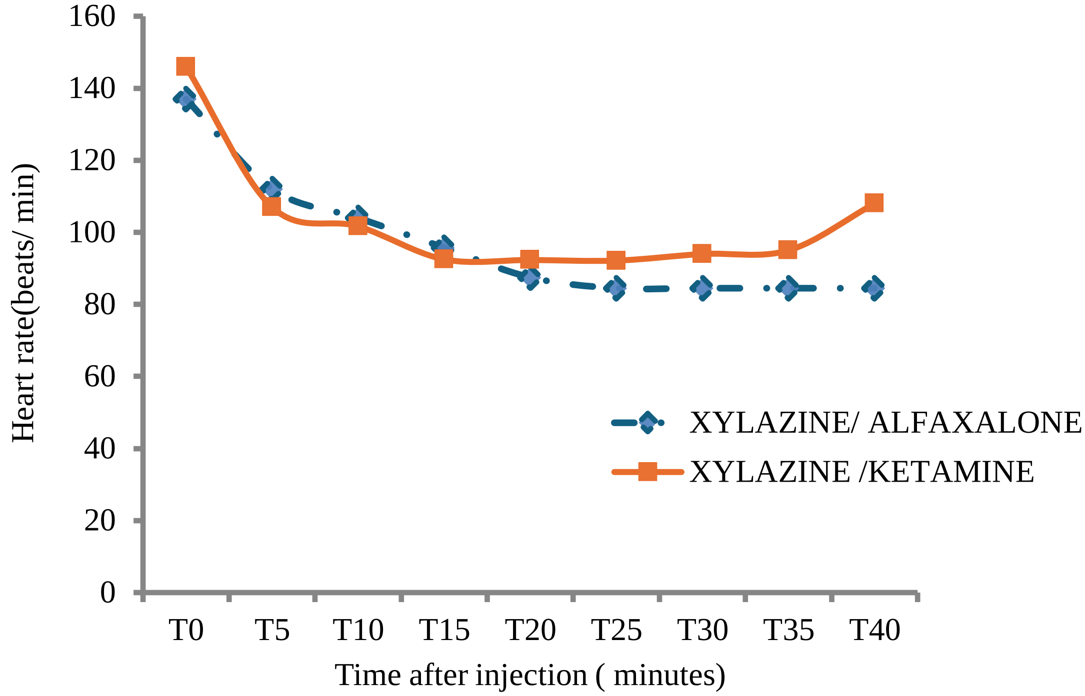

Figure 2: Effect of the combination of alfaxalone/xylazine (n=4) and ketamine/xylazine (n=6) on heart rates on chicken

DISCUSSION

This study demonstrated that both alfaxalone-xylazine and ketamine-xylazine combinations are effective intravenous anaesthetic protocols for local chickens. Both induced rapid and smooth anaesthesia lasting approximately 40 minutes. Comparison with similar protocols in poultry anaesthesia was difficult since the available literature used solely one component or combination with different preanesthetic (Maskatow et al., 2021; White and Martine-Taboada, 2019; Maiti et al., 2006).

Alfaxalone-xylazine was associated with transient apnoea and cyanosis not observed in ketamine-xylazine, highlighting the need for oxygen supplementation or assisted ventilation when using this combination. Several causes of apnoea have been reported in association with anaesthesia in humans, which include anaesthetics themselves, hypocarbia-induced respiratory depression and sometimes the causes cannot be explained (Barach, 2003). During general anesthesia, there is a loss of muscle tone of the upper airway muscles because of decreased cortical influences and chemoreceptor drive and modulation of chemoreceptor input resulting in obstruction or loss of muscle tone (Hillman, Platt and Eastwood, 2003) leading to reduced breathing, slow down breathing rate and consequently decrease oxygen levels. A previous study by Mastakow et al (2021) utilizing alfaxalone at 7.5mk/kg alone or alfaxalone 4mg/kg in combination with either 2mg/kg burtophanol or 0.5mg/kg midazolam given intramuscularly showed no apnoea. Similarly incremental dosages of alfaxalone from 5mg/kg to 15mg/kg IV showed no apnoea apart from rough induction at lower doses (White and Martine-Taboada, 2019) but depression of respiration was reported on xylazine (2mg/kg) and ketamine (10mg/kg) combination in chicken (Maiti et al., 2006). In the present study, the causes of transient apnoea in chickens may likely be caused by the augmenting effects of xylazine to alfaxalone. This effect was not seen in ketamine combined with xylazine although the premedication drug was given at an equal potent

https://doi.org/10.4314/tvj.v41i2.6

dose to all subjects. Both protocols significantly depressed heart and respiratory rates, consistent with known pharmacological effects of xylazine as an α_2-adrenoceptor agonist (Short, 1992).

Figure 3. Change in comb colour following xylazine-alfaxalone administration: before injection (left side: pink) and 10 minutes after alfaxalone injection (right side: pale bluish-pink)

Previous studies in poultry and other species have reported variable induction times and cardiopulmonary effects with these agents depending on dosage and route of administration. Our results align with reports that co-administration of xylazine enhances sedative and muscle relaxant effects while mitigating excitatory side effects of ketamine or alfaxalone.
Ketamine effects on the upper respiratory muscles remain controversial (Hwang et al., 1983; Nishino.et al, 1984). In domestic animals, the presence of many receptors which ketamine acts upon may result in differential stimulation and depression which is also likely to be modulated by xylazine co-administration. In dogs and cats' apnoea is associated with increasing doses (Muir et al., 2008 and 2009) and possibly by the speed of injection (Amengual et al., 2013). In dogs, co-administration of alfaxalone and xylazine administered for over 60 seconds did not result to apnoea (Psatha et al. 2011). In the present study, a similar approach was used, and it is believed the speed of injection not to be a contributing factor to observed apnoea in chicken. The actual mechanisms of observed apnoea in chickens given a combination of alfaxalone and xylazine need to be investigated and rule out the species predisposition as seen in some wild birds (Cooper, 1985, Gribb and Haigh, 1977).
In the present study, both alfaxalone-xylazine and ketamine-xylazine combinations induced a significant reduction in heart rate, this is attributed to a decreased sympathetic outflow from the CNS and vagal reflex on the baroreceptor attributed to xylazine (Davis 1980) and/or other alpha$_2$-adrenoreceptor agonists (Alitalo et al., 1986) or the modifications induced by alfaxalone co-administration with xylazine (Fathi El-Hawari et al., 2017). On the contrary, both ketamine (Sear, 1991) and Alfaxalone (Muir et al, 2008; 2009) are known to cause excitement and tachycardia when given alone but in this case, tachycardia did not develop. The side effects of many anaesthetics including ketamine and alfaxalone are usually attenuated by combining pre-anaesthetics like xylazine. Our results align with reports that co-administration of xylazine enhances sedative and muscle relaxation effects while mitigating excitatory side effects of ketamine or alfaxalone (Sear, 1991).
In this study, both xylazine-ketamine and xylazine-alfaxalone combinations induced a progressive decline in cloacal temperature throughout the 40th minute of observation which concurs with the properties of xylazine on alpha$_2$ receptors on the

skin (Short, 1992; and brain (Livingstone, et al., 1984) and when xylazine is combined with ketamine (Irwin et al., 2023) or alfaxalone (Fathi El-Hawari et al., 2017). The lowering of temperature seen is contributed by xylazine (Irwin et al., 2023) while ketamine effect appears to increase temperature due to metabolic activation and skin vasoconstriction, the interplay between the two at a clinically balanced dose leads to sustainable non-lethal lowering on rectal temperature.

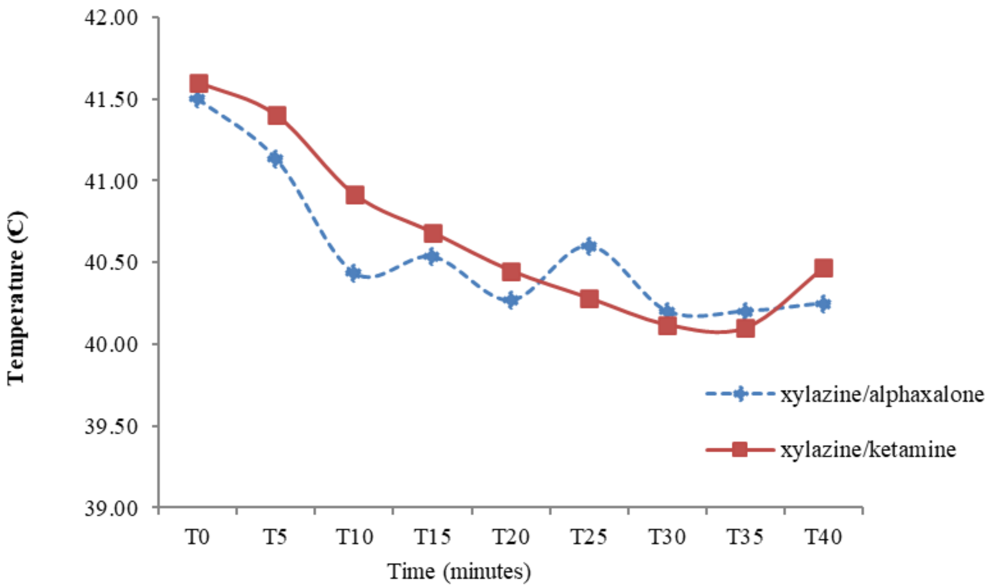

Figure 4: Effect of xylazine/alfaxalone (n=4) and xylazine/ketamine (n=6) combination on cloacal temperature on chicken

To our knowledge, this is the first controlled evaluation of alfaxalone-xylazine in Tanzanian local chickens. The findings provide baseline data for clinical use and research in anaesthesia. However, the data presented must be interpreted with caution as the sample size was small.

CONCLUSION

This pilot study shows that both alfaxalone-xylazine and ketamine-xylazine combinations can induce smooth intravenous anaesthesia in local chickens, lasting about 40 minutes. The small sample size limits generalizability, and transient apnoea with alfaxalone-xylazine highlights the need for oxygen supplementation or assisted ventilation. Because the analysis relied on simple unpaired t-tests that do not account for repeated measures, these findings should be viewed as preliminary baseline data. Larger studies using robust statistical methods are required to confirm safety and establish solid recommendations for routine poultry anaesthesia.

ACKNOWLEDGEMENTS

The authors acknowledge Sokoine University of Agriculture, College of Veterinary Medicine and Biomedical Sciences, and the Department of Veterinary Surgery and Theriogenology for material and technical support.

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