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*Research Article*

# Electrocardiographic Study of Rescued White-bellied Pangolins *(Phataginus tricuspis)* Immobilized with Xylazine Combination

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**ABSTRACT**

Optimal health is required in endangered species and one of the vital organs to assess the overall health of an animal is the heart. The Electrocardiograph (ECG) provides information on the health status of the heart. There is dearth of information on the electrocardiographic parameters of white bellied pangolins. In this study, we obtained cardiac parameters from clinically healthy white-bellied pangolins (n=26) rescued from trade in Southwestern Nigeria. The Pangolins were sedated with Ketamine hydrochloride (10mg/kg) and Xylazine (3mg/kg). Electrocardiography was recorded with the animal on dorsal recumbence using a 6/7 lead computer ECG machine. Standard bipolar (I, II, III) and augmented unipolar (aVR, aVL and aVF) leads readings were recorded. Measurements are presented as mean±standard deviation. Electrocardiogram (ECG) readings were analysed using Descriptive statistics, Student t-test at 5% level of significance. Electrocardiographic parameters such as heart rate (HR), P-wave duration, PR-interval, QRS duration, QT interval, QTc interval and Ra were recorded for each of the leads. The HR ranged from 54 to 109 beats/min with a mean ± standard deviation of 82.85±13.50 beats/min. Lead II recordings showed a P-wave duration of 61.19±16.73 ms, PR interval 94.88±18.88 ms, QRS duration 50.77±16.05 ms, QT interval 299.88±31.23 ms, QTc interval 347.88±37.07 ms and Ra 1.28±0.38 mV. There were no significant differences in the ECG parameters between male and female white-bellied pangolins in all the leads measured. The findings of this study should provide clinical reference for healthy management of African pangolins. It would also serve as a reference values for further research.

**Keywords:** *White-bellied pangolin, Phataginus tricuspis, electrocardiography.*

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## INTRODUCTION

One of the eight pangolin species still in existence is the white-bellied pangolin (*Phataginus tricuspis*) which is native to Africa (Challender and Waterman, 2017, Ogunleye *et al*., 2022). They are the most common African pangolin, presently being the most trafficked in Nigeria (Morenikeji *et al*., 2022), and listed as endangered species according to the IUCN Red List. (Pietersen *et. al*, 2019)

To assess the health of free-ranging, recovering, and confined populations of pangolins, a better knowledge of baseline health values are required. Unfortunately, these data are lacking (Tang *et al*, 2019). Electrocardiography provides crucial information for the clinical examination of heart function and perhaps structure to monitor animals with different cardiac disorders (Larsson *et al*., 2008). The electrocardiogram could also be used as a non-invasive means of monitoring the heart's electrophysiological system functions, particularly regarding how test drugs in toxicology studies affect different parameters that cannot be measured using other techniques and lack morphological correlates that could be seen by histopathology (Hanton and Rabemampianina, 2006). Several heart conditions such as arrhythmias, conduction abnormalities, and myocardial hypertrophy can be detected and diagnosed using ECG.

Little has been reported on the cardiovascular diseases of pangolins with an article stating the electrocardiographic parameters of 6 white-bellied pangolins. (Tang *et al*, 2019) The current study aims to contribute baseline data on electrocardiographic parameters in healthy white-bellied pangolins and broaden the understanding of cardiac changes in pangolins.

## MATERIALS AND METHODS

**Selection of Pangolins for the Study:** White-bellied pangolins rescued from trade by the Pangolin Conservation Guild Nigeria (PCGN) were used for the study while being stabilized and prepared for release to protected conservation forest. The pangolins were rescued from states across the Southwestern parts (Oyo, Ondo, Ogun, Osun and Lagos) of Nigeria between November, 2020 and July 2022.

**Ethical Approval:** Ethical approval for the study was obtained from the Animal Care and Use Research Ethics Committee (ACUREC) of the University of Ibadan with ethical approval number UI-ACUREC/18/0137.

**Electrocardiography:** This study was performed on a total of twenty-six clinically healthy white-bellied pangolins (fifteen males and eleven females) rescued from trade in Nigeria. Electrocardiography was carried out using a 6/7 lead computer ECG machine, (EDAN VE-1010, Shanghai, China) following chemical immobilization with Ketamine and Xylazine combination because of the propensity of pangolins to roll up to expose the dorsum which is protected with thick keratinized scales. Each animal was placed on dorsal recumbency on an insulated platform with the limbs positioned perpendicularly to the long axis of the body. Electrocardiographic alligator clips were attached to scale-less skin to which gel had been applied to establish good skin contact. Clips were attached to both right and left forelimbs, right and left hind limbs and precordial to the left side of the sternum (over the area of the heart). Standard bipolar (I, II, III) and augmented unipolar (aVR, aVL and aVF) leads readings were recorded. Electrocardiographic parameters such as heart rate (HR), P-wave duration, PR interval, QRS duration, QT interval, QTc interval and Ra were recorded for each of the leads.

**Statistical Analysis:** Electrocardiographic data obtained were summarized using descriptive statistics and Student's t-test. Values are presented as mean ± standard deviation. Data analysis was done using Microsoft Excel (2016) software and graph pad prism 5.0.

## RESULTS

Heart rate ranged from 54 to 109 beats/min with a mean ± standard deviation (mean ± SD) of 82.85±13.50 beats/min. Average electrocardiographic parameters are presented in Table 1.

In all the pangolins studied, normal sinus rhythm was recorded and no arrhythmias were observed. Every QRS complex had a preceding P-wave. The P-wave was monophasic and with positive polarity in leads I, II, III, aVL and aVF but was negative in lead aVR. The R-wave amplitude was positive in leads I, II, III, and aVF while it was negative in leads aVR and aVF. Similarly, the T wave was positive in leads I, II, III and aVF while it was negative in leads aVR and aVL ECG parameters including heart rate, P-wave, PR interval, QRS duration, QT segment, QTc and Ra were also compare for sex differences between male and female pangolins but there was no significant difference in the parameters between male and female pangolins in Leads I, II, III, aVR and aVL and aVF parameters. (Tables 2- 7) It was found that all the parameters were higher in male than female although the differences were not statistically significant

**Table 1.**
Electrocardiographic parameters of White-Bellied Pangolins immobilized with xylazine

| Lead | P-wave duration (ms) | PR-interval (ms) | QRS duration (ms) | QT-interval (ms) | QTc (ms) | Ra (amp) |
|---|---|---|---|---|---|---|
| **I** | 63.38±19.80 | 116.31±17.90 | 0.09 | 286.08±50.30 | 332.58±50.99 | 0.48±0.22 |
| **II** | 61.19±16.73 | 94.88±18.88 | 50.77±16.05 | 299.88±31.23 | 347.88±37.07 | 1.28±0.38 |
| **III** | 53.42±20.26 | 112.15±19.56 | 39.88±11.13 | 279.62±35.13 | 328.73±32.69 | 0.98±0.56 |
| **aVR** | 63.23±14.76 | 113.08±18.17 | 35.88±6.13 | 280.92±31.70 | 326.81±30.29 | 0.03±0.06 |
| **aVL** | 54.81±19.52 | 113.92±18.11 | 35.65±9.51 | 262.92±55.76 | 304.12±47.52 | 0.14±0.17 |
| **aVF** | 59.46±24.51 | 110.92±19.08 | 39.54±11.10 | 290.58±33.30 | 338.04±33.25 | 1.07±0.51 |

**Table 2:**
Lead I parameters Based on Sex

| Sex | HR | P | PR | QRS | QT | QTc | Ra |
|---|---|---|---|---|---|---|---|
| F | 83.72±3.26 | 69.09±4.04 | 111.64±4.058 | 31.55±3.11 | 273.18±10.02 | 321.27±12.63 | 0.48±0.07 |
| M | 82.7±4.01 | 65.06±6.29 | 119.73±5.17 | 32.93±2.73 | 295.53±15.67 | 340.87±15.06 | 0.49±0.06 |

*The unit of measurement of ECG parameters are as follows: HR (ms), P wave (ms) PR interval (ms) QRS (ms), QT (ms), QTc (ms) Ra (amp). Values were expressed as mean±SD and significant measured at P<0.05*

**Table 3:**
Lead II Parameters based on Sex

| Sex | HR | P | PR | QRS | QT | QTc | Ra |
|---|---|---|---|---|---|---|---|
| F | 81.17±3.93 | 60.50±4.27 | 91.75±4.42 | 50.83±4.67 | 297.42±9.67 | 339.42±10.30 | 1.331±0.08 |
| M | 82.20±4.01 | 60.60±4.81 | 97.2±5.40 | 50.00±4.18 | 305.53±8.32 | 353.67±9.56 | 1.26±0.12 |

*The unit of measurement of ECG parameters are as follows: HR (ms), P wave (ms) PR interval (ms) QRS (ms), QT (ms), QTc (ms) Ra (amp). Values were expressed as mean±SD and significant measured at P<0.05*

**Table 4:**
LEAD III Parameters Based on Sex

| Sex | HR | P | PR | QRS | QT | QTc | Ra |
|---|---|---|---|---|---|---|---|
| F | 81.12±3.93 | 47.67±6.23 | 103.25±4.99 | 38.83±2.80 | 278.00±9.50 | 320.17±8.08 | 1.0762±0.13 |
| M | 82.20±4.01 | 56.73±4.86 | 117.81±5.01 | 40.73±3.11 | 285.60±10.54 | 335.53±8.87 | 0.93±0.10 |

*The unit of measurement of ECG parameters are as follows: HR (ms), P wave (ms) PR interval (ms) QRS (ms), QT (ms), QTc (ms) Ra (amp). Values were expressed as mean±SD and significant measured at P<0.05*

**Table 5:**
Lead AVR Parameters Based on Sex

| Sex | HR | P | PR | QRS | QT | QTc | Ra |
|---|---|---|---|---|---|---|---|
| F | 81.17±9.93 | 59.25±3.28 | 104.75±4.09 | 35.00±1.40 | 280.42±10.39 | 322.08±8.54 | 0.02±0.01 |
| M | 82.2±4.01 | 65.40±4.36 | 118.07±5.09 | 36.67±1.78 | 285.40±8.25 | 330.20±7.84 | 0.03±0.17 |

*The unit of measurement of ECG parameters are as follows: HR (ms), P wave (ms) PR interval (ms) QRS (ms), QT (ms), QTc (ms) Ra (amp). Values were expressed as mean±SD and significant measured at P<0.05.*

**Table 6:**
Lead AVL Parameters Based on Sex

| Sex | HR | P | PR | QRS | QT | QTc | Ra |
|---|---|---|---|---|---|---|---|
| F | 81.17±3.93 | 50.17±5.48 | 109.33±4.44 | 35.25±2.89 | 245.92±12.35 | 289.17±14.34 | 0.13±0.05 |
| M | 82.20±4.01 | 58.60±4.92 | 116.67±5.08 | 35.93±2.35 | 267.8±18.38 | 306.3315.11 | 0.14±0.04 |

*The unit of measurement of ECG parameters are as follows: HR (ms), P wave (ms) PR interval (ms) QRS (ms), QT (ms), QTc (ms) Ra (amp). Values were expressed as mean±SD and significant measured at P<0.05*

**Table 7:**
Lead AVF Parameters Based on Sex.

| Sex | HR | P | PR | QRS | QT | QTc | Ra |
|---|---|---|---|---|---|---|---|
| F | 81.17±3.93 | 50.93±4.91 | 102.17±3.88 | 37.83±1.79 | 287.08±8.97 | 330.33±7.61 | 1.09±0.14 |
| M | 82.20±4.01 | 65.20±7.15 | 116.73±5.35 | 40.93±3.51 | 297.47±9.76 | 343.67±948 | 1.09±0.14 |

*The unit of measurement of ECG parameters are as follows: HR (ms), P wave (ms) PR interval (ms) QRS (ms), QT (ms), QTc (ms) Ra (amp). Values were expressed as mean±SD and significant measured at P<0.05*

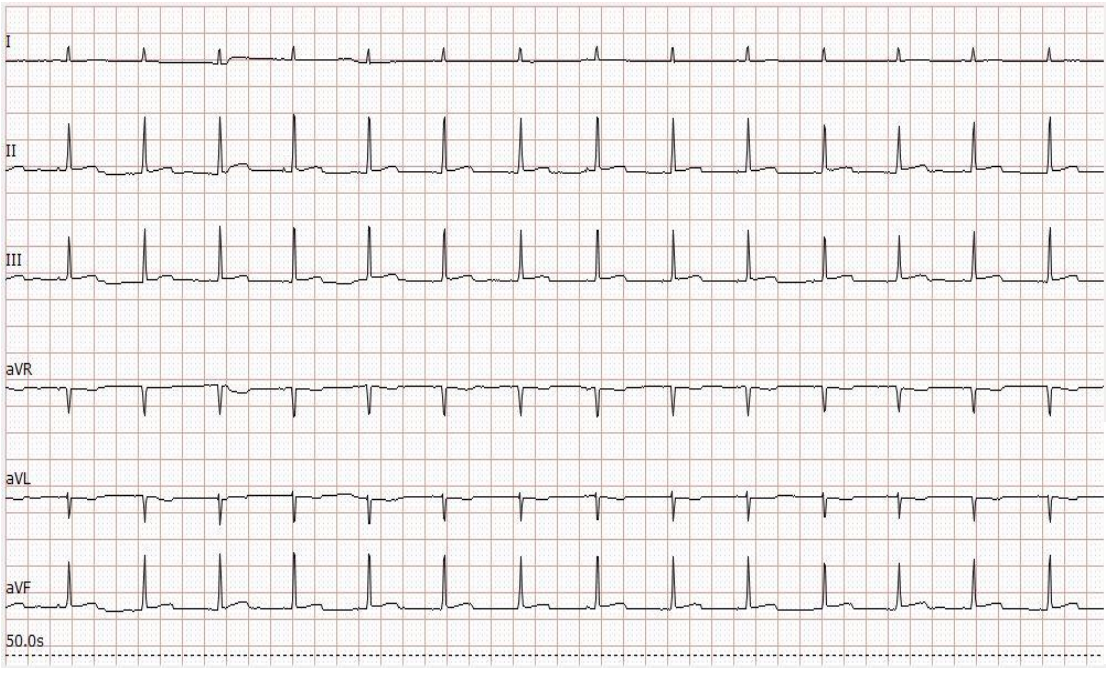


**Figure 1.**
Representative six – lead ECG in white-bellied pangolin (*Phataginus tricuspis*) immobilized with xylazine (10mm/mV, 50mm/s)

## DISCUSSION

Animals can be evaluated for their cardiac health using electrocardiography in infectious, non-infectious, endocrine and metabolic conditions (Olkowski and Classen, 1998; Hassanpour *et al*., 2009). In this study, the first electrocardiographic data from clinically healthy male and female white-bellied pangolins is presented. Additionally, new reference ranges for the clinical assessment of heart function are provided. Tang *et al*. (2019) reported and highlighted in his study on the heart of six healthy white-bellied pangolins anesthetized with gaseous anaesthetic agent (either isoflurane or sevoflurane) that data on the electrocardiography in the species and all pangolin species were not available. This is probably due to rarity of evaluating cardiac parameters in health assessment of pangolin. Research access in this area is also restricted in part due to the pangolins' conservation status. Administration of ketamine and xylazine results in bradycardia and lengthened PR and QT intervals on the electrocardiogram in goats (Kinjavdekar *et al*., 1999; Kramer *et al*., 1996) but no study is available to justify the extent of ketamine and xylazine effects on cardiac parameters. The present study also compared the ECG parameters in male and female pangolins, and we observed that the values were numerically higher in males than females although the differences were not statistically significant in all the leads evaluated. These findings are in agreement with the work of Wicker *et al*. (2020) who reported that there were no significant differences in ECG parameters based on sex in pangolins. MacFarlane (2018) however reported that ECG parameters in humans are affected by age and sex, the later demonstrated by a longer QRS duration in men than women. Similarly, Lue *et al*. (2018) reported significant sex differences in ECG parameters in 71 percent of the population of adolescent studied.

This study will serve as a clinical reference for veterinary practitioners and academics looking at the cardiovascular health of African pangolins. It will also offer electrocardiography reference data for white-bellied pangolins. It is necessary to conduct more research to examine the cardiac parameters in conscious, non-sedated pangolins.

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