# Comparative Anaesthesia of Galahs

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## Introduction

The comparative physiological effects of halothane and isoflurane as sole anaesthetic agents in galahs were evaluated. Ten galahs were induced and maintained with each agent, provided by either an endotracheal tube or by mask. Anaesthetic gases were warmed and humidified before being supplied to the patients. A surgical plane of anaesthesia was maintained for 60 minutes. Repeated measurements of heart rate, temperature, respiratory rate and function, and serum biochemistry and electrolytes were taken during and after the anaesthetic episodes.

## Materials and Methods

### *Birds*

Galahs of mixed age and gender were obtained from a local bird retailer (Eddie Davis Bird Dealer). The birds were banded with individually numbered steel leg bands to provide identification and housed as a colony in a partially enclosed outdoors flight.

Post purchase, the birds were in average body condition, with several of the birds showing evidence of an upper respiratory tract infection. This was treated with a 9 week course of doxycycline in the drinking water (Psittavet, Vetafarm).

### *Anaesthetic Agents and Routes of Administration*

In each trial, the same 10 galahs were studied. Isoflurane and halothane were each administered by mask or endotracheal (ET) tube. Unless otherwise stated, the anaesthetic equipment remained standard across all trials.

Isoflurane was provided in a Fluotec Mark 2 vaporizer, factory modified for isoflurane. Halothane was provided in a Fluotec Mark 2 vaporizer. The vaporizer outflow was passed through a heated water bath to heat and humidify the inspired gases. The gases passed through an Ayres t-piece to the bird. The bird was connected to the Ayres t-piece by either an anaesthetic mask imposing a total equipment dead space of approximately 75 ml or a shortened size 2.5 uncuffed endotracheal tube imposing a total equipment dead space of approximately 4 ml.

The birds received no premedication agents. All birds were induced by mask administration of the study gas. The birds were manually restrained until they reached a surgical plane of

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anaesthesia. Following induction, endotracheal intubation was performed when required, and instrumentation of the bird was begun. A surgical plane of anaesthesia was maintained for 60 minutes.

***Anaesthetic Gas Humidification and Body Temperature Maintenance***

Anaesthetic gas from the vaporizer was bubbled through a sealed, insulated glass jar of water which had been boiled immediately prior to induction of the bird. The anaesthetic gas achieved a temperature of 35-40˚C at the end of the Ayres t-piece. This temperature was monitored by a thermistor probe placed at the junction of the Ayres t-piece and the mask or endotracheal tube.

The birds were placed on a towel covered heating pad which provided a thermostatically controlled temperature of 50˚C measured between the bird and the heating pad.

***Patient Monitoring***

Anaesthetic depth was monitored by observation of the birds reflex response to noxious stimuli. Induction of anaesthesia was assessed by the loss of wing and foot withdrawal reflexes. Once these reflexes were absent and the palpebral response was reduced but still present, the bird was considered to be in a surgical plane of anaesthesia.

During anaesthesia, the presence of pedal and wing ECG clips (alligator clips) provided constant stimulation allowing early detection of the return of withdrawal reflexes. Alterations of heart and respiratory rate were assessed in conjunction with these reflexes to determine if they were caused by variation in anaesthetic depth.

Heart rate, respiratory rate and cloacal temperature were measured every ten minutes during the study. Respiratory rate was monitored by counting sternal movements over a one minute period. Heart rate and rhythm was monitored by 5 second three-lead ECG tracing (leads I, II and III). Body temperature was monitored by cloacal thermometer.

At the end of the experiment, the bird was disconnected from the anaesthetic system. No additional oxygen was provided. The bird was loosely wrapped in a towel, the endotracheal tube removed (if present) and the bird placed in the holding cage. No external stimuli were applied to speed recovery. The bird was observed until it was standing in a normal position with its head and wings held in a normal attitude, at which time the time for recovery was recorded.

***Sample Collection and Measurement***

1) *Serum Biochemistry and Electrolytes*

Samples for serum biochemistry and electrolyte measurement were collected immediately post induction, at the conclusion of 1 hour of anaesthesia and approximately 24 hours post anaesthesia. These sample times were chosen to provide a baseline, to detect immediate and/or transient biochemical changes and to detect delayed or persistent changes, respectively.

All blood samples were collected from a teflon catheter placed in the right jugular vein following induction. For each collection, the first 0.2 ml of blood was discarded to

reduce the risk of collecting blood from the catheter lumen. Following each use of the catheter, it was flushed with 0.2 ml of heparinised saline (10 IU/ml).

The parameters evaluated were: creatinine kinase (CK), alkaline phosphatase (ALP), aspartate aminotransferase (AST), phosphorus, urea, uric acid, calcium, cholesterol, glucose, protein, albumin, sodium, potassium and chloride. A total of 1.6 ml of whole blood was required to run each combined biochemistry and electrolyte panel.

2) *Blood Gas Analysis*

Samples were drawn for blood gas analysis immediately following induction, then every 20 minutes until the end of anaesthesia. Venous blood (0.2 ml) was collected from the jugular catheter following disposal of the initial 0.2 ml of blood sample. These samples were collected into pre-chilled heparinised plastic syringes, avoiding the introduction of air bubbles. Any air bubbles were expelled immediately after sample collection. The samples were capped, placed into a ice/water slurry and analyzed within 5 minutes of collection.

Analysis was performed on a Radiometer ABL5 automatic blood gas analyzer. This unit provided results corrected for temperature. Parameters measured were: sample pH, carbon dioxide partial pressure ($pCO_2$), oxygen partial pressure ($pO_2$), oxygen saturation ($sO_2$), bicarbonate concentration ($HCO_3$-), actual base excess (ABE) and total carbon dioxide ($tCO_2$).

**Table 1: Summary of Blood Collection Times and Volumes**

| Time | Tests Performed | Blood Volume |
|---|---|---|
| 0 minutes | Biochemistry<br>Electrolytes<br>Blood gas analysis | 1.6 ml<br><br>0.2 ml |
| 20 minutes | Blood gas analysis | 0.2 ml |
| 40 minutes | Blood gas analysis | 0.2 ml |
| 60 minutes | Biochemistry<br>Electrolytes<br>Blood gas analysis | 1.6 ml<br><br>0.2 ml |
| 24 hours | Biochemistry<br>Electrolytes | 1.6 ml |
| | **Total Blood Volume** | **5.6 ml** |

***Statistical Evaluation of Data***

The data were found to be normally distributed following assessment using histograms. Paired students t-tests were used to test for significant difference both over time within a single protocol and at the same time across protocols.

## Summary of Results

All except two birds remained healthy throughout the experimental period. One bird died on induction of anaesthesia using isoflurane after the bird had escaped from a holding cage and one died at the end of 1 hour of halothane anaesthesia. No evidence of disease was detected by necropsy and histopathological examination of these birds.

1) *Observations*

Body temperature decreased consistently and significantly with all anaesthetic agents, despite attempts to maintain body temperature. The depression of body temperature was more profound with halothane than with isoflurane, regardless of means of administration.

Both respiratory rate and heart rate were higher throughout the experiment with halothane than isoflurane. In all cases both respiratory rate and heart rate decreased with time under anaesthesia.

Recovery time was more prolonged with halothane than isoflurane. There was no difference between mask or ET tube administration.

2) *Hepatocellular Function Indicators*

CK was elevated at the end of anaesthesia and 24 hours post anaesthesia under all protocols. ALP was depressed at 60 minutes and 24 hours post anaesthesia with all protocols.. AST levels were unchanged at 60 minutes, but were elevated at 24 hours. There was no significant difference between anaesthetic agents or methods of delivery for any of these measurements.

3) *Renal Function Indicators*

Urea was unchanged after 60 minutes, but was elevated at 24 hours, with no difference between anaesthetic agents or methods of delivery. Uric acid was depressed at 60 minutes with all anaesthetic agents, but was elevated after 24 hours, especially with halothane.

4) *Other Biochemical Parameters*

Both protein and albumin were depressed after 60 minutes of anaesthesia. These levels had returned to normal after 24 hours. There was no difference between protocols.

Calcium was depressed with halothane by mask after 60 minutes and 24 hours post anaesthesia. Calcium levels for isoflurane by tube and mask and halothane by tube were all unchanged after 60 minutes and elevated 24 hours post anaesthesia.

Phosphorus was elevated at 60 minutes but normal at 24 hours post anaesthesia for all anaesthetic protocols. Cholesterol levels were unaffected by anaesthesia.

Glucose levels were depressed with isoflurane (by mask or ET tube) after 60 minutes, but had normalised after 24 hours post anaesthesia. Halothane (by mask and ET tube) resulted in elevated blood glucose levels after 60 minutes, which had normalised after 24 hours.

5) *Electrolytes*

Sodium levels were unchanged after 60 minutes of anaesthesia. 24 hours after anaesthesia levels with isoflurane were elevated, and levels with halothane depressed, halothane by mask resulting in more depression than halothane by ET tube.

Potassium levels were depressed at 60 minutes, halothane levels being more depressed than isoflurane. After 24 hours, most levels remained depress, especially birds anaesthetised by halothane by mask.

Chloride levels were all depressed after 60 minutes of anaesthesia. After 24 hours, the chloride levels of birds anaesthetised with isoflurane had returned to normal while the levels of those anaesthetised with halothane remained depressed.

6) *Respiratory Function*

Plasma pH decreased during anaesthesia with birds anaesthetised by mask. Anaesthetic agents provided by ET tube did not result in significant acidosis. Total bicarbonate and ABE increased with time, with no difference between anaesthetic agents or methods of delivery.

Oxygen saturation was depressed with all treatments after 60 minutes, although this was only significant in birds anaesthetised with isoflurane by mask. However this depression was only mild, with mean oxygen saturation remaining above 93% in all cases. Partial pressure of oxygen was higher in birds anaesthetised by ET tubes, regardless of anaesthetic agent.

Partial pressure of carbon dioxide increased with time in all treatments, halothane by mask causing the most significant elevation. Total carbon dioxide was also elevated with time with all protocols with halothane by mask causing larger elevation than other protocols.

## Conclusions

The most commonly reported adverse reactions to anaesthesia in birds relate to cardiac or respiratory dysfunction (or failure). It is in these areas where the most significant variation between halothane and isoflurane, and the provision of these agents by mask or ET tube were recorded in the present study.

In the present study the main differences between anaesthetic agent were variations in serum electrolyte concentrations and respiratory function. Halothane anaesthesia resulted in more profound disturbance of sodium, potassium and chloride levels, possibly contributing to the higher rate of ECG trace abnormalities reported in the literature for this drug. In addition, provision of halothane by mask caused more disturbance than provision of halothane by ET tube.

Respiratory acidosis occurred only where anaesthetic agents were provided by mask, regardless of the anaesthetic agent provided. Oxygen partial pressures were higher when ET tubes were used than masks, once again regardless of anaesthetic agent. Both total and partial pressures of carbon dioxide were higher in birds anaesthetised by halothane by mask, suggesting both a drug effect and a dead space effect with mask administration.

This results suggest that halothane anaesthesia causes more significant respiratory depression than isoflurane. In addition, the potential to cause more significant electrolyte disturbances may predispose halothane anaesthetised birds to cardiac arrythmias. The results also suggest that use of a mask rather than an ET tube to deliver anaesthetic gases further

increases these disturbances.
Conclusions from the present study:

- Isoflurane administered by ET tube was the preferred agent for anaesthesia of galahs.
- Birds which escape from holding cages should be allowed to fully recover following recapture before general anaesthesia is attempted.
- Provision of isoflurane by mask caused little alteration of measured values and this method of anaesthetic delivery may thus be appropriate for short procedures which require general anaesthesia.
- Halothane resulted in more profound respiratory depression and electrolyte disturbances, which were significantly greater with mask administration. When halothane is to be used for anaesthesia it is preferable to provide it by ET tube to minimise these disturbances.

## Further Reading

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