Airsac Administration of Isoflurane Anaesthesia in Sulphur Crested Cockatoos (*Cacatua galerita*)

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Introduction

Airsac intubation for the administration of inhalational anaesthesia in birds was first described in the 1970s (Whittow et al 1970). Since then, it has become a widespread practice both for administration of anaesthesia and to allow ventilation in cases of failure of the upper respiratory system (Piiper et al 1970, Fedde et al 1986, Rode et al 1990). Airsac anaesthetic administration has the advantages of allowing free surgical access to the head and upper respiratory system; precise control of the plane of anaesthesia, a route for emergency respiratory support during an anaesthetic crisis, and airsac tubes can be left *in situ* following anaesthesia to provide longer term respiratory support (Rode et al 1990, Mitchell et al 1999, Korbel et al 1996). Despite the invasiveness of airsac intubation in comparison to conventional endotracheal intubation, there is little evidence for significant damage to airsacs following short term placement of airsac tubes (Mitchell et al 1999). There have been few reports of the effects of airsac intubation and inhalational anaesthetic administration on respiratory function in birds (Korbel et al 1996, Korbel et al 1993, Korbel 1998) despite its widespread use. This current study compares the effects on respiratory function of isoflurane anaesthesia administration via an endotracheal tube, the caudal thoracic airsac and the clavicular airsac in sulphur crested cockatoos (*Cacatua galerita*).

Materials and Methods

Birds and anaesthetic conditions

Ten adult sulphur crested cockatoos were used in this study. Each bird was anaesthetised twice, once for caudal thoracic (CT) airsac intubation and once for clavicular airsac intubation, with at least 2 weeks between anaesthetic episodes. For each protocol, anaesthesia was induced by mask administration of isoflurane in O_2. Following induction, the bird was weighed, then intubated. Temperature support was provided by a thermostatically controlled heating pad thermostatically placed under the bird. Following stabilisation, a 6 cm long, 3 mm internal diameter ET tube was surgically implanted into the airsac under study as previously described (Rode et al 1990, Taylor 1994).

Four methods of anaesthetic gas administration were evaluated for each air sac delivery experiment, namely:

1) ET tube open and administering anaesthetic gas, airsac tube closed;
2) ET tube open and administering anaesthetic gas, airsac tube open;
3) ET tube open, airsac tube open and administering anaesthetic gas and
4) ET tube closed, airsac tube open and administering anaesthetic gas.

Three administration methods were undertaken in each bird. The selection and order of administration was determined by a randomised table. Following each change of method of administration, the bird was allowed to equilibrate for 15 minutes before sampling was performed.

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Blood gas and gas-in-gas analysis

Following stabilisation, a 2-3 mm sample of gas was collected from the relevant airsac or at the end of the ET tube. These samples were assayed for oxygen and carbon dioxide partial pressures (pO_2 and pCO_2 respectively). In addition, a 100 µl arterial blood sample was collected from either the ulnar artery or the carotid artery and a 100 µl venous blood sample was collected from the jugular vein, and were assayed for pH, pCO_2, pO_2, oxygen saturation (sO_2), bicarbonate (HCO_3^-), total carbon dioxide tCO_2, and base excess (ABE). Gas-in-gas and blood gas samples were assayed within 3 minutes of collection and were stored at room temperature between collection and assay.

Spirometry

Immediately following gas and blood sampling, spirometry measurements were performed. The flow head was attached to either the ET tube or airsac tube and spirometry traces collected for a minimum of 60 seconds from each tube, allowing calculation of peak inspiratory and expiratory rate, inspiratory, expiratory and total respiratory period, respiratory rest period, respiratory rate and minute and tidal volume.

Discussion of results

Anaesthesia was successfully maintained in all birds via ET tube or caudal thoracic airsac administration. Clavicular airsac administration was unsuccessful in all cases. Anatomical evaluation and gas-in-gas analysis of the clavicular airsac suggests that this airsac is poorly ventilated in sulphur crested cockatoos under conditions of anaesthesia.

All birds continued to spontaneous ventilate throughout the study period, although birds undergoing airsac administration with the ET tube open showed clinically reduced respiratory movements. Peak inspiratory and expiratory rate and inspiratory and expiratory periods were maximal when a single tube was open (either ET or airsac). With both tubes open, respiratory flow was distributed between both tubes resulting in shorter inspiratory and expiratory periods and a longer rest rate. This resulted in a relatively stable total respiratory time and RR regardless of the method of administration. Similarly, the sum of minute and tidal ventilation across both tubes remained constant regardless of administration method.

Blood gas analysis revealed arterial and venous hyperoxia and normocapnia with all administration methods. As demonstrated above, ventilatory function was not compromised by this hyperoxia. Contrary to previous reports, CO_2 "washout" did not occur with airsac administration. Other blood gas parameters were not significantly different between anaesthesia delivery methods. Significant respiratory alkalosis did not occur.

Conclusion

In sulphur crested cockatoos, administration of isoflurane anaesthesia via caudal thoracic airsac intubation was shown to be safe and reliable and caused minimal alteration in respiratory function in comparison to ET tube administration. To maintain obvious respiratory movement and to minimise the risk of inhalation of waste anaesthetic gases, it may be preferable to block the ET tube or trachea when providing caudal thoracic airsac anaesthesia. Despite successful use reported in non-psittacine birds, clavicular airsac intubation for the provision of ventilation and maintenance of anaesthesia cannot be recommended in sulphur crested cockatoos.

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