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POSTURAL CHANGES AND END-TIDAL CARBON DIOXIDE IN THE BLACK RHINOCEROS (DICEROS BICORNIS) AND ITS IMPORTANCE TO FIELD ANESTHESIA

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Background:

The African black rhinoceros is endangered and interventions for its conservation depend on safe chemical restraint practices. Since rhinoceros capture protocols use potent opioids as a foundation for restraint, respiratory depression with hypoventilation, hypoxia, and hypercapnea are common. Given the respiratory compromise inherent with opioids, debate surrounds the optimal posture (sternal or lateral) to maintain a rhinoceros during anesthesia. The objective of this study was to examine respiratory parameters before and after a postural change in wild black rhinoceros using capnography and blood gas analysis.

Methods:

Thirty-six black rhinoceros (age 3-33 years) were immobilized by remote injection from a helicopter using etorphine and azaperone. End-tidal carbon dioxide ($ETCO_2$) and contemporaneous carbon dioxide tension in an auricular vein (PCO_2) were measured on 27 recumbent rhinoceros before and after a postural change using a side-stream capnograph (Microcap plus) and a handheld clinical analyzer (i-STAT), respectively. Sampling frequency for PCO_2 occurred before and after a change in posture while serial $ETCO_2$ measures were recorded once per minute. Twenty-one rhinos were moved from lateral to sternal posture, 3 from sternal to lateral, and 4 changed posture on more than one occasion.

Results:

Thirty-two postural change events were used in the analysis. With a postural change from lateral to sternal (n=25), $ETCO_2$ in lateral was 38 (37, 39) mmHg [median (first quartile, third quartile)] and in sternal it was 48 (45, 50) mmHg; PCO_2 in lateral posture was 41 (35, 50) and in sternal it was 43 (31, 46) mmHg (Figure 1). With a postural change from sternal to lateral (n=7), $ETCO_2$ in sternal was 49 (45, 50) mmHg and lateral it was 38 (36, 39) mmHg. The observed change in $ETCO_2$ began immediately upon a postural change and was evident within one or two breaths.

Conclusions:

These data show that $ETCO_2$ changes with posture in captured, recumbent rhinoceros yet auricular venous carbon dioxide does not appear to change. While further study will be necessary to elucidate causation for observed disparities in $ETCO_2$ with postural change in the rhinoceros, the authors hypothesize that the nearly instantaneous rise in $ETCO_2$ observed in immobilized black rhinoceros when moved from lateral to sternal posture (and decline in $ETCO_2$ when moved from sternal to lateral) indicates a change in physiologic dead space. Although most field anesthesia monitoring of endangered rhinoceros focus on oxygenation (as measured by pulse oximetry), the data supplied by serial $ETCO_2$ monitoring could provide important new information to enhance decision-making at this hazardous time. Additionally, these results may be of interest in humans and their physiologic response to position.

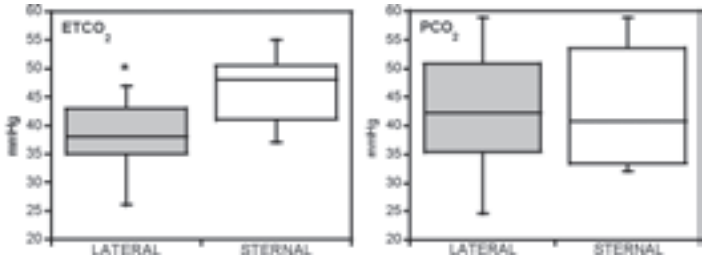

*Figure 1. Box plots illustrating the difference in ETCO2, but not PCO2, between lateral and sternal posture in recumbent immobilized black rhinoceros. * = p<0.001*

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