

# 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<sub>2</sub>) and contemporaneous carbon dioxide tension in an auricular vein (PCO<sub>2</sub>) were measured on 27 recumbent rhinoceros before and after a postural change using a side-stream capnograph (Figure 1) (Microcap plus) and a handheld clinical analyzer (i-STAT), respectively. Sampling frequency for PCO<sub>2</sub> occurred before and after a change in posture while serial ETCO<sub>2</sub> 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.

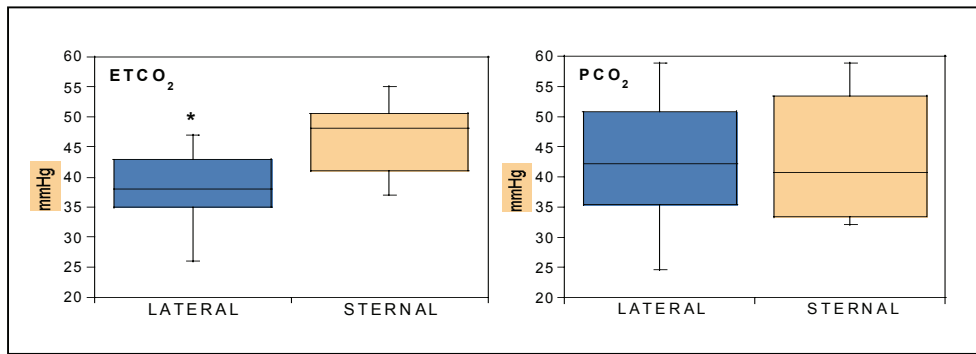
**Results:** Thirty-two postural change events were used in the analysis. With a postural change from lateral to sternal (n=25), ETCO<sub>2</sub> in lateral was 38 (37, 39) mmHg [median (first quartile, third quartile)] and in sternal it was 48 (45, 50) mmHg; PCO<sub>2</sub> in lateral posture was 41 (35, 50) and in sternal it was 43 (31, 46) mmHg (Figure 2). With a postural change from sternal to lateral (n=7), ETCO<sub>2</sub> in sternal was 49 (45, 50) mmHg and lateral it was 38 (36, 39) mmHg. The observed change in ETCO<sub>2</sub> began immediately upon a postural change and was evident within one or two breaths.

**Conclusions:** These data show that ETCO<sub>2</sub> 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<sub>2</sub> with postural change in the rhinoceros, the authors hypothesize that the nearly instantaneous rise in ETCO<sub>2</sub> observed in immobilized black rhinoceros when moved from lateral to sternal posture (and decline in ETCO<sub>2</sub> 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<sub>2</sub> 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.

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**Figure 1**



**Figure 2.** Box plots illustrating the difference in ETCO<sub>2</sub>, but not PCO<sub>2</sub>, between lateral and sternal posture in recumbent immobilized black rhinoceros. \* =  $p < 0.001$ .