INFLUENCE OF POSITION ON VENTILATION IN THE AFRICAN BLACK RHINOCEROS (DICEROS BICORNIS) UNDERGOING ANESTHESIA IN THE WILD

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Background: The black rhinoceros *(Diceros bicornis)* is critically endangered with just over 4,000 animals surviving in southern Africa. Conservation efforts utilize potent opioids as a foundation for chemical restraint, resulting in respiratory depression, hypoventilation, hypoxemia, and hypercarbia. Preliminary data on the influence of posture on respiratory function was reported here (STA, 2009) but the debate over optimal positioning of rhinos during anesthesia continues. The purpose of this study was to expand on earlier findings and characterize the effects of posture on respiration during field anesthesia of free-ranging black rhinoceros.

Methods: Twenty-four black rhinoceros were anesthetized by remote injection of etorphine and azaperone; 15 rhinos (11 male, 4 female; age 2.5 - 30 yr) had complete sets of data and were included in the analysis. Initial posture was systematically alternated between lateral (LAT) (n=9) and sternal (STE) (n=6) postures. Following initial data collection in one posture the animals were moved into the alternate posture and data collection repeated. Expired gas was collected and measured (Wright's respirometer), while simultaneous arterial blood gas samples were analyzed for $PaCO_2$ (iSTAT). End-tidal CO_2 ($P_{ET}CO_2$) and mean exhaled CO_2 ($P_{\bar{E}}CO2$) were measured with a side stream capnograph (Microcap plus or Capnostream 20). Ventilatory data was indexed for size by dividing values by spine length (m). Data were analyzed with descriptive, inferential (t-test or Mann-Whitney U Test), and general multivariable linear analysis methods using commercially available software (SAS Ver. 9.2)

Results: The average time from darting to data collection for posture 1 was 27.6 ± 4.7 min (mean ± SD) and 45.8 ± 6.6 min for posture 2. Nine rhinos were placed in LAT and 6 in STE during posture 1. Average spine length was 2.28 ± 0.17 m. Minute ventilation (VE) averaged 86.8 ± 22.8 L/min, VE/spine averaged 38.0 ± 9.8 L/min/m, tidal volume (VT) averaged 13.7 ± 4.4 L, VT/spine averaged 6.0 ± 1.8 L/m, dead space (VD) averaged 2.5 ± 2.6 L, VD/spine averaged 1.1 ± 1.1 L/m, and VD/VT averaged 18.6 ± 18.5%. $PaCO_2$ averaged 48.5 ± 9.2 mmHg. There were no postural or time differences noted in the above values. $P_{ET}CO_2$ averaged 43.3 ± 5.3 mmHg and was greater in STE (46.7 ± 4.0 mmHg) than in LAT (40.0 ± 4.2 mmHg) $P< 0.001$. $P(A\text{-}a)O_2$ averaged 19.3 ± 11.2 mmHg and was larger in LAT (26.1 ± 5.9 mmHg) than in STE (12.6 ± 11.3 mmHg) ($P = 0.001$). No time differences were noted in $P_{ET}CO_2$ or $P(A\text{-}a)O_2$ values.

Conclusions: In African Black Rhinoceros undergoing anesthesia in the wild, neither posture nor time affected ventilatory parameters (VE, VT, RR, VD). $P_{ET}CO_2$ was smaller and $P(A\text{-}a)O_2$ larger in LAT position when compared to STE irrespective of time. Although these changes in $P_{ET}CO_2$ and $P(A\text{-}a)O_2$ are consistent with changes in ventilation/perfusion (with greater deadspace ventilation in LAT position), we could not measure a postural difference in VD. Possible explanations for this inconsistency include postural effects on cardiovascular function or physiologic shunt, as well as difficulties in collection and measurement of exhaled gases and/or arterial blood.