Blood Gas Measurements in a White Rhinoceros Calf Using i-STAT Handheld Clinical Analyzer

DID YOU KNOW?

- The White Rhinoceros is second only to the African elephant is size of land mammals.
- The white rhinos are believed to have the most complex social structure of all rhino species.

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A White Rhinoceros calf was immobilised for ear notching in the South East Lowveld area of Zimbabwe. Several blood samples were collected during the procedure and analysed using CG4+ cartridges and the i-STAT analyzer.

The animal was darted from a helicopter using Palmer darting system with 2.2 mg etorphine, 40 mg azaperone and 2500 IU hyalase. Once the animal was immobilised blood samples were collected and analyzed as per the table below:

Comments

Initial pH was mildly acidotic, primarily due to elevated carbon dioxide and lactate in the blood associated with exertion. This was likely due to depressed ventilation as reflected by the low oxygen saturation and partial pressure of oxygen in the blood. After giving butorphanol

Comments	Sample	Position	Nasal O_2	Minutes post darting	pH	pCO_2	pO_2	BE	HCO_3	TCO_2	sO_2%	Lactate
First sample	Arterial	Sternal	No	8	7.30	60.7	49	4	30	32	79	4.14
After 15mg Butorphanol iv	Arterial	Sternal	No	13	7.33	55.8	65	4	29.7	31	90	2.72
5 min after starting nasal O_2	Arterial	Sternal	Yes	18	7.31	65.9	73	8	33.7	36	92	2.1
3 minutes after placing in lateral recumbancy	Arterial	Lateral	Yes	23	7.32	54.8	66	3	28.7	30	91	1.46
Walking after another 15 mg and 2 mg diprenorphine	Arterial	Standing	No	35	7.38	57.4	61	9	34	36	90	1.13
3 minutes after placing in lateral recumbancy	Venous	Lateral	Yes	23	7.31	64	54	6	32.7	35	84	1.87

IV (without supplemental oxygen), the pH increased due to decreased carbon dioxide and lactate. The decrease in carbon dioxide was likely a result of improved ventilation since the oxygen saturation and partial pressure of oxygen increased. Another sample was taken approximately 5 minutes after initiating nasal oxygen administration. Interestingly, the arterial pH decreased (become slightly more acidotic) due primarily to a respiratory acidosis (increased partial pressure of carbon dioxide) although the lactate continued to decrease. The oxygen saturation value did not dramatically change (90 to 92% with oxygen), although there was a larger change in the partial pressure of arterial oxygen (65 to 73 mmHg). The hypothesis is that the nasal oxygen may have decreased the stimulus for respirations and there was passive diffusion of oxygen into the alveoli resulting in a greater diffusion gradient into the blood, but with less breaths, the expiration of carbon dioxide was decreased. This is supported by the increase in total carbdon dioxide and bicarbonate at this sample time. After moving the rhino from sternal to lateral recumbency, another sample was taken (approx. 3 mins later). The arterial pH increased primarily due to decreased partial pressure of carbon dioxide (from 65.9 to 54.8 mmHg) and continued decrease in lactate. As expected, the partial pressure of oxygen decreased (73 to 66 mmHg) although there was an insignificant change in oxygen saturation values (92 to 91%). Once the animal was partially reversed with additional butorphanol and M5050, it was walked and a standing arterial sample analyzed. There was a jump in the pH back to "normal" levels (7.38) although partial pressure of carbon dioxide increased slightly (54.8 to 57.4 mmHg) and lactate continued to decrease. Oxygen saturation remained at 90% although partial pressure of oxygen decreased slightly since the rhino was no longer receiving nasal oxygen (66 to 61 mmHg). There was an increase in both bicarbonate and total carbon dioxide at this point.

Additional venous samples were analyzed and compared. In the ear, arterial and venous samples were concurrently measured. pH was similar, although partial pressure of carbon dioxide and oxygen were higher and lower, respectively in the venous sample. Lactate was slightly higher in the venous sample as expected since this is diffusing into the capillary beds at the tissue level.

Conclusions (based on this single rhinoceros)

Butorphanol administration appeared to improve respiratory acidosis and oxygenation of the blood, probably through improved ventilation. This data needs to be assessed in light of respiratory rates and estimated tidal volume (subjectively assessed by movement of air at the nares). Administration of nasal oxygen improved arterial levels of oxygen but exacerbated respiratory acidosis by potentially affecting respiratory "drive" (note: significant change in base excess of the interstitial fluid after administration). Lateral recumbency improved acidosis by lowering carbon dioxide levels although it also affected oxygen values (PO_2), presumably due to ventilation-perfusion mismatch.

Sampling site, posture, arterial vs venous samples, administration of partial antagonist-agonists and oxygen all affect results.

Comments

Administration of partial antagonist-agonist should be investigated as a possible alternative to administration of nasal oxygen to improve ventilation in immobilized white rhinoceros.