The Journal of Veterinary Medical Science

FULL PAPER

Surgery

Influence of changing lateral recumbency and mode of ventilation on the alveolar-arterial oxygen tension gradient and selected laboratory analytes in adult isoflurane anesthetized horses

Sirirat NIYOM[1)], Khursheed R. MAMA[2)]*, Melissa KING[2)], Erin CONTINO[2)], Dora FERRIS[2)], Alex VALDES-MARTINEZ[3)], David D. FRISBIE[2)], Wayne MCILWRAITH[2)] and James ZUMBRUNNEN[4)]

[1)]Department of Companion Animal Clinical Sciences, Faculty of Veterinary Medicine, Kasetsart University, Bangkok 10900, Thailand

[2)]Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO 80523, U.S.A.

[3)]Department of Environmental & Radiological Health Sciences, Colorado State University, Fort Collins, CO 80523, U.S.A.

[4)]Department of Statistics, Colorado State University, Fort Collins, CO 80523, U.S.A.

ABSTRACT. This study investigated the influence of changing recumbency and mode of ventilation over repeated anesthesias on the alveolar to arterial oxygen tension gradient ($P_{A-a}O_2$) and laboratory analytes in eight horses during a year-long imaging study. Anesthesia was induced with xylazine, diazepam or guaifenesin, and ketamine and maintained with isoflurane. Horses were positioned in right or left lateral recumbency for computed tomography. Ventilation was controlled during 47% of the anesthetics. Blood was sampled from an arterial catheter prior to (30 ± 5 min from connection to anesthetic circuit), within 5 min of changing lateral recumbency, and prior to circuit disconnection (24 ± 6 min after second sample) for measurement of pH, partial pressure of arterial oxygen (PaO_2) and partial pressure of arterial carbon dioxide, blood glucose and electrolytes. $P_{A-a}O_2$ was calculated. Data from five anesthetic episodes for each horse were summarized as mean ± standard error and analyzed using a mixed-model ANOVA. *t* tests were used for pairwise comparisons ($P<0.05$). PaO_2 decreased after turning (198 vs. 347 mmHg), then increased to 291 mmHg prior to disconnection. Correspondingly, $P_{A-a}O_2$ was wider (252 vs.120 mmHg), and improved before disconnection (190 mmHg). Body temperature, ionized-Ca^{2+} and blood glucose were lower, and Na^+ was higher at the last time point. In conclusion, turning anesthetized horses decreases PaO_2 and results in a widening $P_{A-a}O_2$ suggesting a cautious approach in animals with pre-existing hypoxemia.

KEY WORDS: altitude, alveolar-arterial oxygen gradient, anesthesia, changing position, horse

J. Vet. Med. Sci.
80(10): 1584–1589, 2018
doi: 10.1292/jvms.18-0032

Received: 15 March 2018
Accepted: 20 August 2018
Published online in J-STAGE: 3 September 2018

General anesthesia is associated with a reduction of oxygenation and ventilation in human beings [9, 21, 26, 30] and animals [40]. Hypoxemia is commonly described in anesthetized horses and maintained in both dorsal and lateral recumbency at sea level [6, 15, 17, 19, 24, 33]. Major causes of the lowered partial pressure of arterial oxygen (PaO_2) include drug induced hypoventilation, and ventilation/perfusion (V/Q) mismatching due to postural and gravitational effects [8, 20, 23, 31].

Prior reports in anesthetized horses also indicate that PaO_2 decreases are exacerbated when horses are turned from dorsal to lateral recumbency [16], from left to right lateral recumbency [23] and from right lateral to dorsal recumbency [12]. The influence of the ventilation mode on oxygenation has also been demonstrated [6, 12, 36]. However, factors influencing oxygenation such as arterial carbon dioxide tension ($PaCO_2$) or fraction of inspired oxygen (FiO_2) were either not measured or not standardized in these studies. Therefore, we elected to measure these factors and assess mode of ventilation, recumbency and the influence of changing the same in horses anesthetized at 1,525 m above sea level while undergoing computed tomography (CT) imaging for another study.

*Correspondence to: Mama, K.: kmama@colostate.edu