REDUCTION OF RESPIRATORY DEPRESSION DURING CHEMICAL
IMMOBILIZATION OF HERBIVORES

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ABSTRACT

Chemical capture using potent opioids is essential for the effective management and conservation of many wildlife species. Potent opioids are unparalleled in their ability to induce a rapid, reversible, catatonic immobilization. However, the beneficial effects of opioids are coupled with significant side-effects, most notably respiratory depression, to which white rhinoceros are particularly sensitive. Current treatments aimed at reversing opioid-induced respiratory depression (or respiratory compromise) have not been systematically compared. Moreover, the treatments do not appear to fully correct the hypoxaemia, hypercapnia and acidosis.

I therefore investigated and compared the effectiveness of current treatments, and also investigated the potential of a new treatment for opioid-induced respiratory depression. I conducted studies in goats and captive (boma-housed) white rhinoceros to reduce the effects of confounding variables that are present in field capture. After identifying the best protocol for reducing respiratory depression in captive rhinoceros, I determined whether that treatment was effective in field-immobilized rhinoceros.

In my first study, I compared the ability of two opioid agonist-antagonists to reverse etorphine-induced respiratory depression in immobilized goats by measuring respiratory parameters continuously, together with intermittent arterial blood gas measurements. I found that butorphanol more successfully reversed the etorphine-induced respiratory depression than did nalbuphine. In a controlled cross-over trial in boma-immobilized white rhinoceros, I then compared the efficacy of the treatments butorphanol, oxygen, and butorphanol combined with oxygen, in reversing etorphine-induced respiratory depression. Butorphanol (without oxygen) improved, but did not correct the hypoxaemia, hypercapnia and acidosis, while oxygen insufflation on its own exacerbated the hypercapnia and acidosis, and did not improve oxygenation. When butorphanol was combined with oxygen insufflation, the severe
etorphine-induced hypoxaemia in immobilized white rhinoceros was completely corrected, however some hypercapnia and acidosis persisted.

Subsequently, I tested the butorphanol with oxygen treatment in field-immobilized rhinoceros. I found that the response to the helicopter chase altered the animal’s physiology such that the high levels of inspired oxygen did not completely normalize arterial blood oxygen partial pressures. However, our treatment significantly improved arterial oxygenation to near-normal partial pressures and reduced hypercapnia and acidaemia compared to pre-intervention values.

Finally, I assessed the cardiorespiratory effects of the ampakine, CX1942, in etorphine-immobilized goats to determine whether ampakines may offer advantages over currently available treatments in their ability to reverse opioid-induced respiratory depression. I demonstrated that the ampakine CX1942 improved arterial oxygenation and ventilation, without increasing arousal. Ampakines potentially offer advantages over doxapram, a conventional treatment, in reversing etorphine-induced respiratory depression in wildlife, but more species-specific studies are needed, and more water soluble and potent ampakines ultimately are required.

In summary, I recommend that to significantly reduce the risk of morbidity and mortality associated with respiratory depression during immobilization of wildlife, particularly white rhinoceros, stressful pursuits before darting should be minimized. Intravenous butorphanol should be administered, and oxygen insufflation initiated, as soon as the animal is recumbent. Potentially, the ampakine CX1942 may also be a successful treatment for opioid-induced respiratory depression, but further research is needed to ensure its use in rhinoceros and other wild animals is safe and effective. Ultimately, we should aim to prevent, rather than treat, opioid-induced respiratory depression in immobilized wildlife. In future, if more soluble and potent ampakines that can be combined with an opioid in an immobilizing dart are formulated, then the risk of opioid-induced respiratory depression could be reduced even further, if not negated.