



Use of Perfluorocarbon (Oxycyte) as Innovative Therapy for Traumatic Spinal Cord Injury

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Introduction

Evidence suggests that decreased oxygen level in spinal cord injury (SCI) exacerbates the initial trauma to the spinal cord leading to irreversible neurological deficits and long-term disability. Enhancing oxygen delivery to injured tissue after SCI is a promising treatment strategy. Perfluorocarbon emulsions have been shown to improve outcomes in TBI models and we have shown that early administration of Perfluorocarbons (Oxycyte 2 ml/kg and 5 ml/kg) decreases hypoxia and preserves white and grey matter in a dose dependent fashion, showing greater improvements with increased dose. We found that the administration of Oxycyte will enhance parenchyma oxygen, prevent cellular injury and parenchymal tissue loss, and improve neurological functions, and that these improvements are dose dependent.

Methods

Two groups of 10 randomly selected Adult Evans female rats were subject to moderate-severe SCI at the T9 level using (MASCIS) II-NYU impactor. SCI group received intravenous injection of 2 or 5 ml/kg of 0.9% saline whereas the Oxycyte group received 2 or 5 ml/kg of Oxycyte. Both groups received 3 h of inhaled oxygen (FiO2 30%) at 5 L/min. Immunohistochemistry analyses and behavioral assessments were used to examine the neuroprotective effects of Oxycyte.

Results

Our current dose response study found that the Basso, Beattie, and Bresnahan (BBB) scale and inclined plane test of both low and high dose Oxycyte treated animal groups were significantly higher as compared to the vehicle group after spinal cord injury ($P < 0.05$). Oxycyte significantly preserved white matter ($P = 0.0076$) and reduced cavity volume ($P = 0.039$) as compared to the control group. The functional recovery score and neuronal protective values of the 2 ml/kg Oxycyte treated group were lower (BBB score 11 ± 1.28) compared to (BBB score 14.6 ± 1.05) the 5 ml/kg group. This suggests that searching for the optimum therapeutic dose and delivery time is warranted.

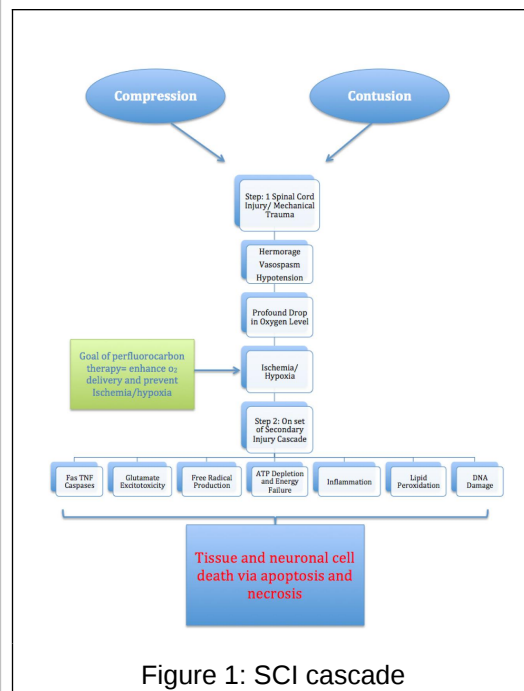


Figure 1: SCI cascade

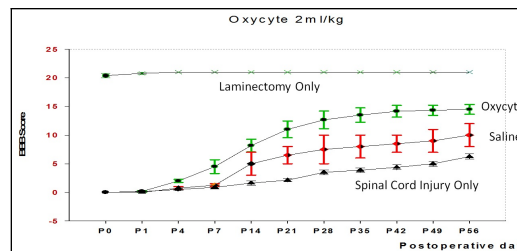


Figure 1: Oxycyte improves locomotor function (average BBB of 13-15) compared to Saline (average BBB of 8-10) and Control (average BBB of 3-5) groups.

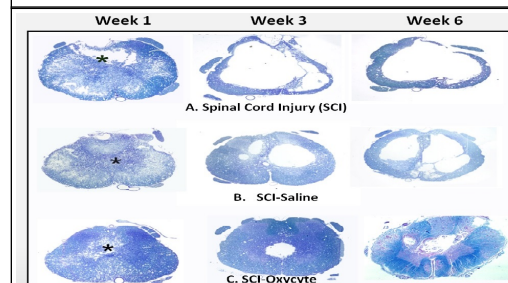


Figure 2: Saline offers some neuroprotection, Oxycyte significantly reduces cavity volume and preserves myelin

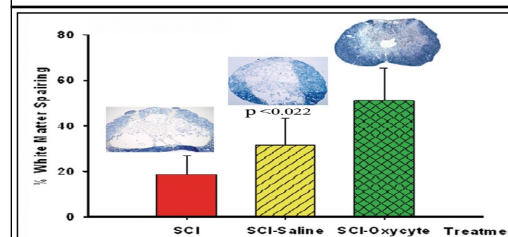


Figure 3: Percent of White Matter Preservation. Oxycyte preserves an average of 50-60%, saline preserves about 35%, and control injury with no treatment results in 15-20% white matter remaining.

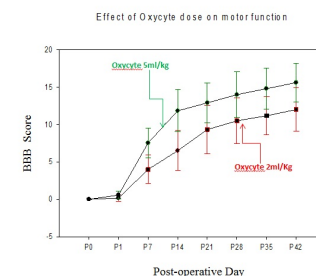


Figure 4: Effect of Oxycyte dose variation on motor function (BBB Score). Oxycyte dose of 5 ml/kg shows improved motor function compared to dose of 2ml/kg.

Conclusion

We demonstrated that Oxycyte enhances early functional recovery after SCI by diminishing cavitation volume and neuronal cell death via anti-apoptotic activity. Oxycyte 5 ml/kg showed higher functional recovery via the BBB score, as well as a decreased lesion size at the spinal cord parenchyma compared to the lower dose. Our new study aims to find the most efficacious dose and delivery time of oxycyte for optimum recovery.

References

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