



TBIOMD 492

The Science Behind the Squeeze: Neurosteroid Control in Foal Recovery from NMS

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Background

Neonatal Maladjustment Syndrome (NMS) affects approximately 3-5% of all newborn foals. Researchers suggest that the cause of NMS is due to insufficient pressure during the second stage of labor, where the birth canal pressure triggers a sharp reduction in sedative neurosteroids. The syndrome produces several behavioral and cognitive impairments that directly hinder neonate development, such as disorientation, deficient nursing, seizures, and more. As a result of NMS, up to 20% of newborn foals die within the first three days of life.

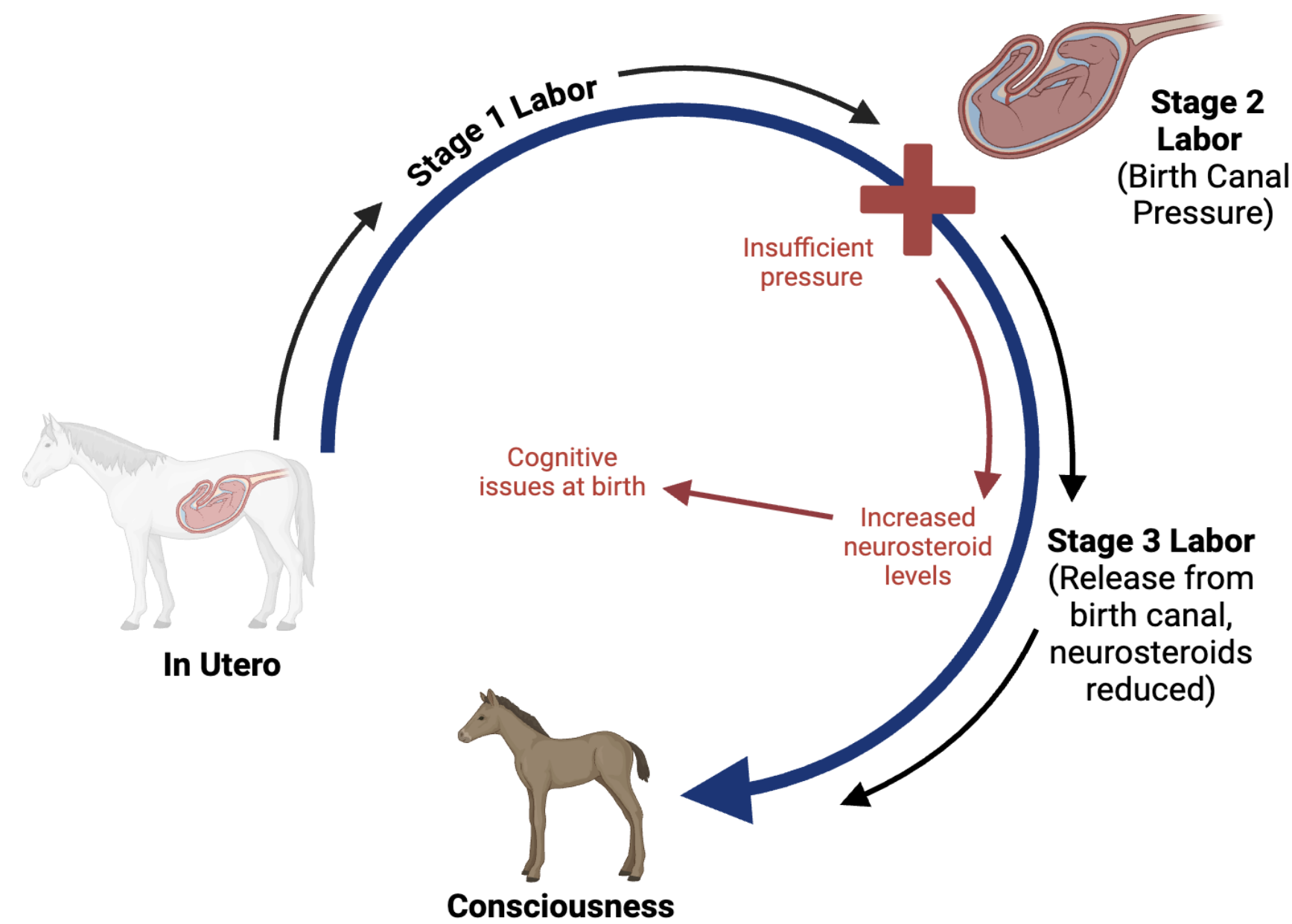


Figure 1. Mechanism linking parturition pressures to neonatal consciousness. This diagram illustrates the transition from intrauterine life through the three stages of equine labor. The birth canal compression during the second stage of labor reduces neurosteroid levels, facilitating the foal's transition to postnatal consciousness. Insufficient pressure during this stage may fail to trigger the reduction, leading to cognitive and behavioral abnormalities. Created with BioRender.com.

Some literature suggests the use of the Madigan Squeeze Technique as a non-invasive and safe treatment for foals with NMS. The technique involves wrapping a rope around a foal's chest and abdomen to mimic the squeeze of the birth canal and trigger the release of neurosteroids, which can reduce or alleviate NMS symptoms

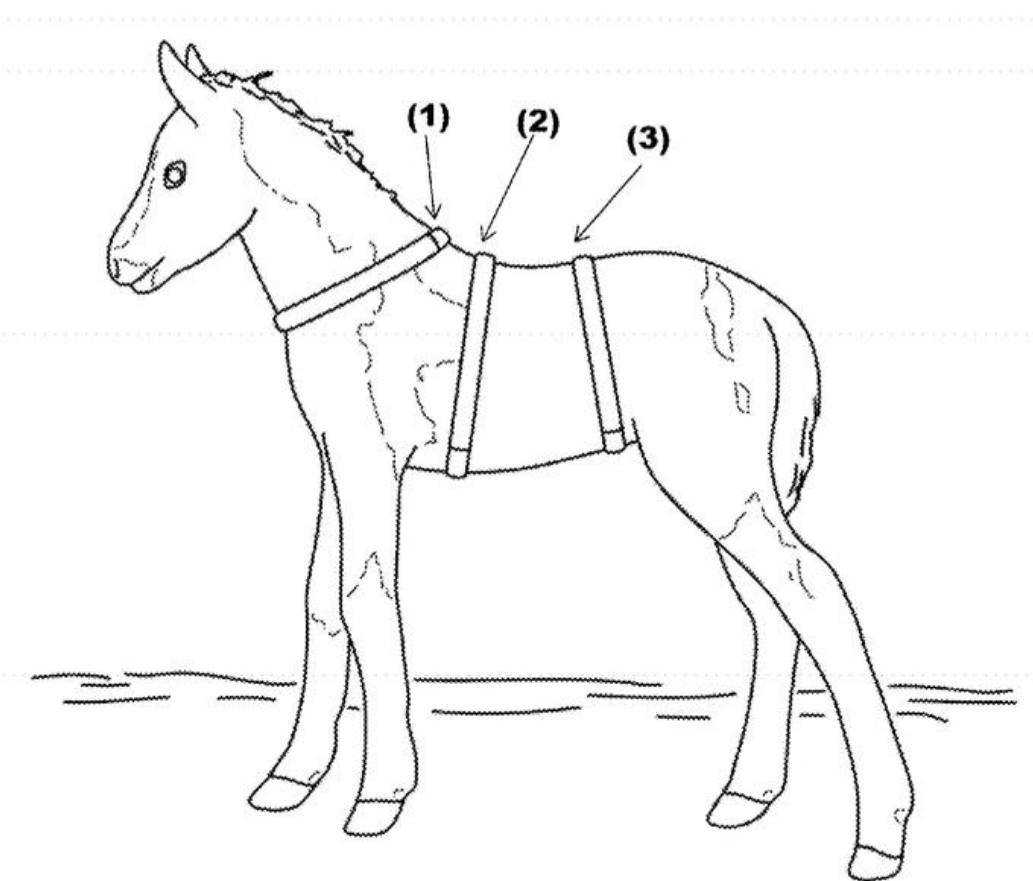


Fig. 4

Figure 2. Application points of the Madigan Squeeze technique on a neonate equine. A supportive strap is placed around the neonate's neck (1) in tandem with a heart-girth cuff (2) and caudal cuff (3) to exert a substantial squeeze of approximately 10psi for 20-30 minutes to reach a state of recumbency (Madigan, Aleman 2016).

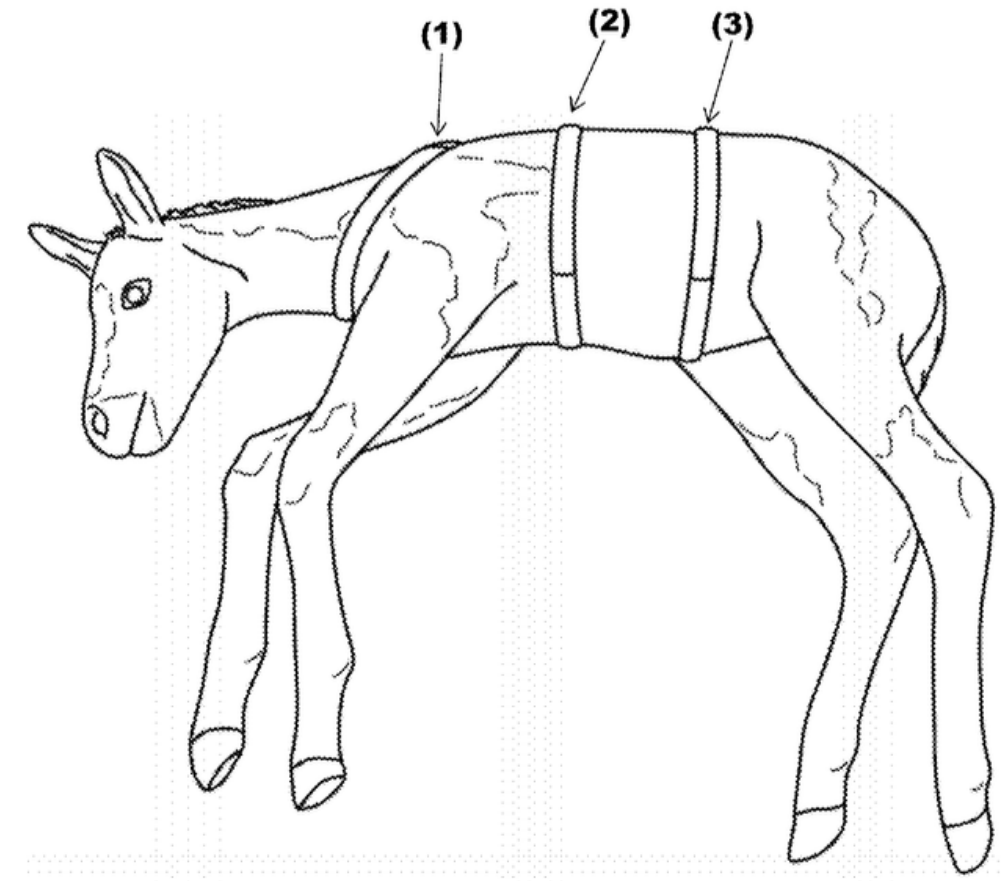


Fig. 5

However, it remains undetermined whether early behavioral improvements translate into permanent cognitive benefits beyond the neonatal period. This critical literature review addresses this gap in research, whether the Madigan Squeeze's effects extend to long-term cognitive and behavioral outcomes of treated foals.

Methods

This literature review focused on existing primary studies on the use of the Madigan Squeeze in treating NMS. Studies assessed included cohort studies of equine foals. Data was compared to existing studies on standard intensive hospitalization in treating NMS to investigate the short-term and long-term effects of the Madigan Squeeze.

Results

Short-term outcomes:

- Rapid improvement of NMS symptoms when treated with the Madigan Squeeze, reducing the need for hospitalization or intensive care
- Squeezed NMS foals have a similar recovery rate to those that are treated with standard intensive care
- The Madigan Squeeze reduced time to full recovery from NMS; foals treated with one or more thoracic squeezes were more likely to recover within an hour to 24 hours post-treatment when compared to standard intensive care (Aleman et al. 2017).
- Short-term evaluations report no adverse effects of the Madigan Squeeze technique (Aleman et al. 2017; Holdsworth et al. 2021); Holdsworth et al. 2022).

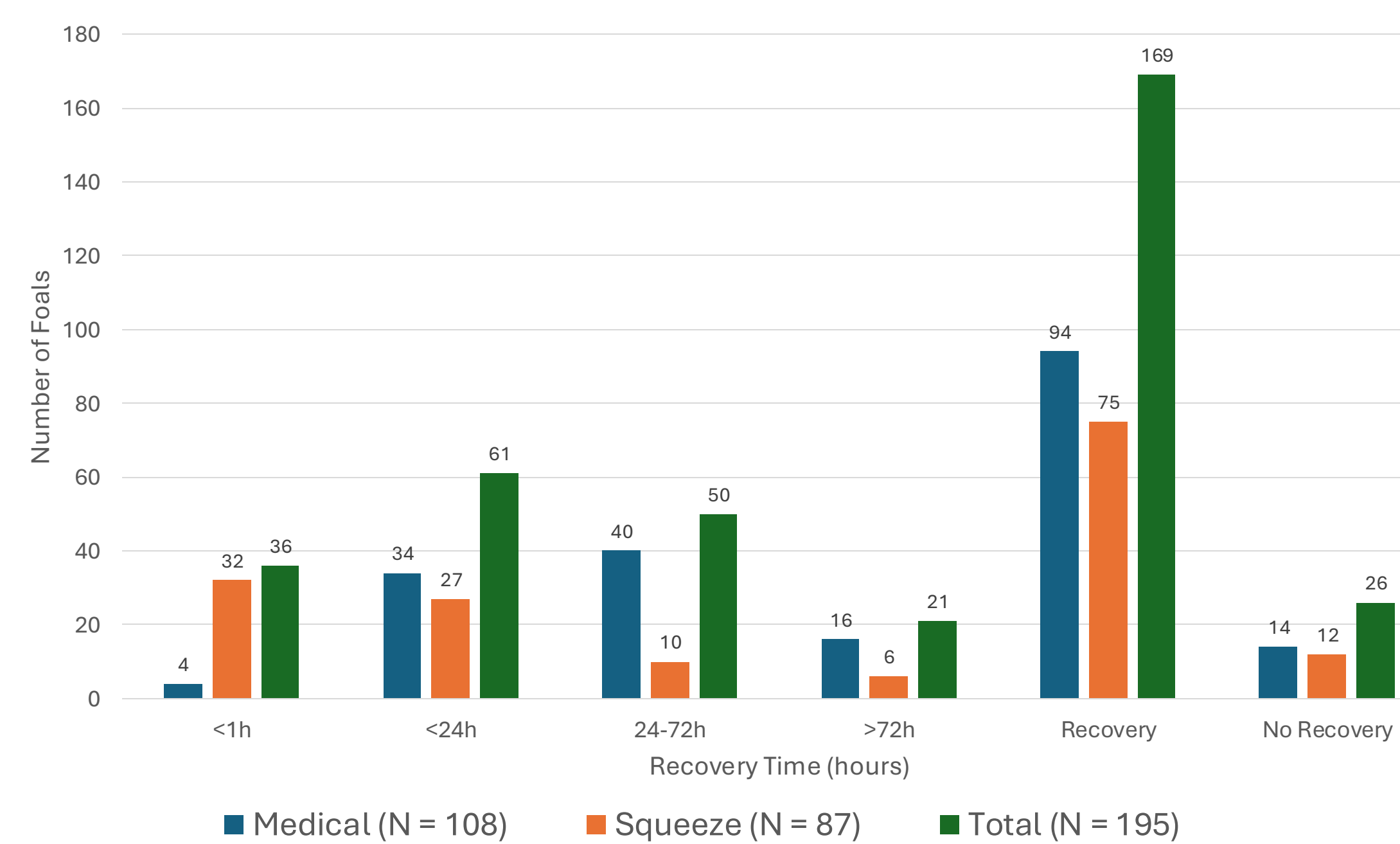


Figure 3. Post-medical and post-squeeze treatment response time of foals with NMS. The number of foals treated with one or more thoracic squeezes showed a faster recovery rate within an hour than medically treated foals. foals treated with one or more thoracic squeezes were 15.1 times more likely to recover within the hour and 17.5 times more likely to recovery within 24 hours when compared to standard intensive care (Aleman et al 2017). Figure created in Excel.

Long-term outcomes

- Researchers examined 23 foals diagnosed with NMS, treated with traditional clinical treatment, suggested normal growth trajectories of survivors despite exhaustive illness (Baker et al. 1986)
- Current research lacks follow-up data of NMS foals treated with the Madigan Squeeze
- However, existing research examining growth trajectories of NMS foals treated with traditional clinical care serves as a good baseline comparison for future research.



Figure 4. A restrained foal receiving the Madigan Squeeze to induce a state of somnolence. In this study, 8 healthy foals were evaluated pre and post squeeze to determine if a rope restraint, the Madigan Squeeze, could replicate the effects of birth canal compression (Toth et al. 2012).

Other Findings:

- The Madigan Squeeze has not yet been fully implemented into standard veterinary practice, which may increase the risk of improper application that leads to injury. (Aleman et al. 2017)
 - Broken ribs, respiratory compromise, neuromuscular disease, cardiomyopathy.
- The success of the Madigan Squeeze has been reported across several mammalian species: healthy newborn calves (Holdsworth et al. 2022), healthy newborn piglets (Holdsworth et al. 2021), and more.

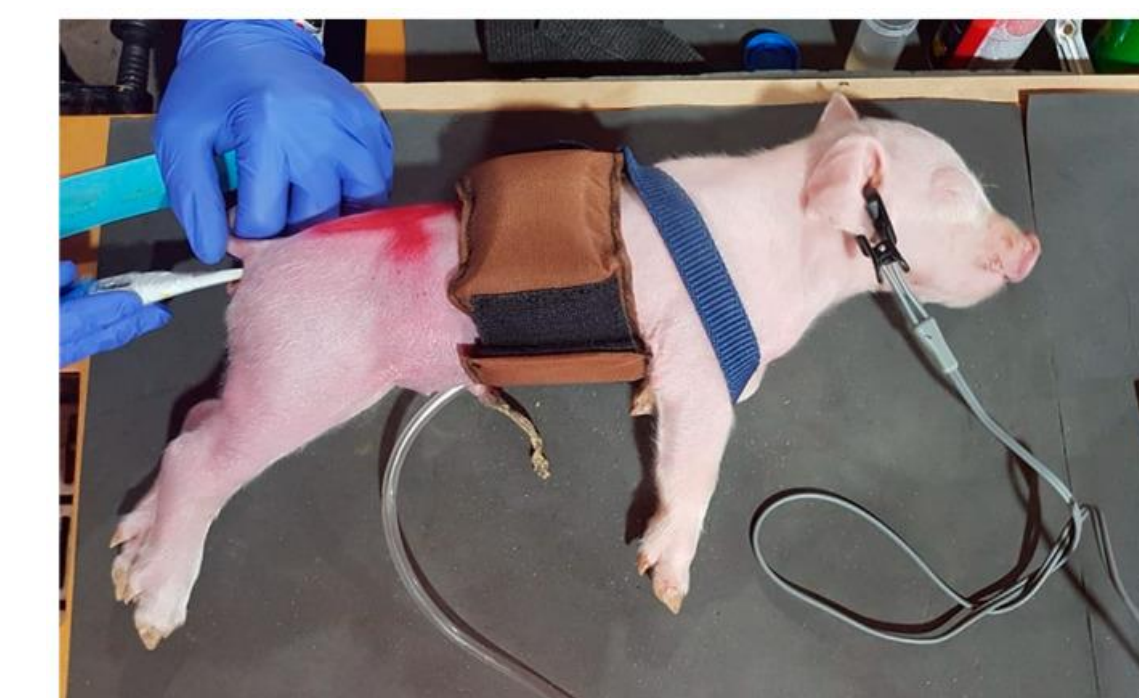


Figure 5. A newborn piglet enduring a thoracic squeeze via an inflation cuff. This image comes from a study that confirmed the use of a thoracic squeeze to induce a less-responsive state, like the use of the Madigan Squeeze in equine foals (Holdsworth et al. 2021). The results of this study support existing research of the mechanisms and underlying responses to the Madigan Squeeze or thoracic compression.

Conclusion

- The Madigan Squeeze effectively lowers persistent neurosteroid levels and reverses symptoms caused by NMS shortly after birth
- Cohorts of foals treated with the Madigan Squeeze shared similar survival rates to those treated with standard intensive hospitalization but recovered more rapidly.
- Current literature establishes the Madigan Squeeze as a rapid-response intervention that reduces the necessity for intensive hospitalization of NMS foals.

Future Research

- High-quality research methods, including randomized controlled trials (RCTs)
- Prioritize short-term and long-term follow-up procedures to assess translation of outcomes into adult equine life.
- Address social responses, stress responses, and physical parameters such as height, weight, and physical performance
- To support existing short-term outcome research, researchers must assess neurosteroid levels of foals before and after applying the Madigan Squeeze
- Assess treated NMS foals and healthy controls with or without the Madigan Squeeze applied to determine deviations in neurodevelopment or mortality rate.
- Conclude whether artificially induced consciousness via the Madigan Squeeze is as effective as birth canal compression in regulating neurosteroids that influence neonatal behavior and cognition.

Acknowledgments

I would like to extend my gratitude to Dr. Tawanda for their mentorship and support throughout completing my goals with this capstone project. I would also like to thank Dr. Heller for their guidance and feedback throughout creating this poster.

References

