Madigan's squeeze technique: a review for equine veterinary nurses

Foals that are affected with neonatal maladjustment syndrome make up 3–5% of the foaling population. A very rapid, assisted vaginal birth or delivery via caesarean section are risk factors for neonatal maladjustment syndrome. This article examines the therapeutic application of Madigan's squeeze technique for neonatal foals diagnosed with neonatal maladjustment syndrome. It discusses the appropriate methods and timing for practitioners to use Madigan's squeeze technique in treating affected foals under the supervision of a veterinarian.

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Foals with neonatal maladjustment syndrome, or dummy foals, appear healthy when they are born, but shortly after, often within the first few hours to days of life, start to show abnormal neurological health: they appear confused, disoriented and unresponsive. They are likely to be detached, aimlessly wander around, and be disinterested in their dam or in nursing. Affected foals exhibit unusual behaviours and neurological signs, like stumbling towards humans (flight animals should be wary of humans) and moving in a disorientated fashion. Unaffected foals will normally be on their feet and feeding, with a strong mother/foal bond within 1–2 hours.

Foals with neonatal maladjustment syndrome are also likely to display metabolic abnormalities, such as reduced ventilation, difficulty with thermoregulation and reduced motility of the gastrointestinal tract. If left untreated, the syndrome can even result in the death of the foal. Neonatal maladjustment syndrome encompasses a range of conditions, from mildly affected foals showing a slight lack of connection with the mare to more severely affected foals that may struggle to stand or nurse, experiencing additional complications. The level of intervention required will vary depending on the severity of the condition in individual foals.

Many foals with neonatal maladjustment syndrome do respond favourably to veterinary care, and around 80% will recover after a short period of 1–2 weeks. A survey of veterinarians using the Madigan's squeeze technique revealed that foals with neonatal maladjustment syndrome who were subjected to squeezing, whether with or without medical therapy, exhibited a 3.7 times higher likelihood of quick recovery compared to non-squeezed foals. Squeezed foals were also reported to have a 15 times greater likelihood of recovery within an hour. Foals receiving only squeezing, without medical intervention, showed a 17.5 times higher likelihood of recovering in the first 24 hours compared to those treated solely with medication. The study found no reported side effects. The research indicated that 12% of all foals and 14% of squeezed foals did not recover. In cases of maladjustment referred to clinics, survival rates in several studies were reported to be 80%. There are a lot of nursing interventions to consider in these cases, and nursing these 'dummy foals' requires round-the-clock, intensive care and feeding via stomach tube or bottle. The extent of the impact on each foal will determine the appropriate course of action. Foals with neonatal maladjustment syndrome face an elevated risk of accompanying conditions like failure of passive transfer, sepsis, meconium retention and more. Emphasising the significance of early detection and intervention becomes crucial in preventing these complications and influencing the prognosis.

Causes of neonatal maladjustment syndrome

Neonatal maladjustment syndrome was originally recorded over a century ago, but recent advances in research have improved veterinary understanding of the pathogenesis of this syndrome. Previously, neonatal maladjustment syndrome was attributed to oxygen deprivation during the birthing process. However, this reasoning was questioned because most foals with this syndrome recover without any lasting effects, which is unexpected for animals experiencing hypoxia. More recently, a theory has been

developed that neurosteroids in the foal's bloodstream that act as sedatives until birth, keeping the foal in a quiet state while in the womb, are the cause of neonatal maladjustment syndrome in foals.

Horses produce precocious offspring. As prey animals, foals must be able to stand and run shortly after birth. To achieve this, the foal needs to stop producing these neurosteroids as it is being born. Physical pressure experienced during birth serves as a crucial trigger for this transition. When the birth is rapid or occurs via caesarean section, the trigger is not received and the foal has a persisting production of neurosteroids and may have a higher incidence of neonatal maladjustment syndrome. Foals with neonatal maladjustment syndrome show elevated levels of neurosteroids in their bloodstream (Holdsworth et al, 2022). Not every affected foal experiences a swift delivery or casaerean section. Numerous cases involve an unexplained failure in the birthing transition process, or belong to subgroups of the syndrome with distinct causes.

Maladjustment symptoms can be artificially induced temporarily in normal, healthy foals by administering short infusions of a neurosteroid called allopregnanolone. When the neurosteroid levels drop, the foals return to their normal state (Madigan et al, 2012).

Historically, neonatal maladjustment syndrome has been linked to oxygen deprivation in the brain, identified as hypoxic ischaemic encephalopathy, resulting in brain damage and insufficient blood flow to nerve cells. It is likely that a subgroup of foals with neonatal maladjustment syndrome still results from secondary hypoxic brain injury. Despite gaining insights into the significance of neurosteroids through recent research, this mechanism may not explain the occurrence of neonatal maladjustment syndrome in all affected foals. Oxygen deprivation can be caused by various factors, such as the abrupt detachment of the placenta from the uterus before foaling, prolonged labour, prematurity, sepsis and brain swelling (for example, as a result of dystocia).

Further research has found that another contributing factor to this syndrome is the failure of the foal's mental state to transition from somnolence within the uterus to consciousness at birth, which typically occurs as the foal passes through the birth canal (Madigan, 2021). During this process, the pressure exerted by the birth canal prevents the release of neurosteroids, which are responsible for maintaining the foal in an unconscious state while in the uterus. When there is no signal to halt their production, these neurosteroids continue to be released, preventing the foal from fully gaining consciousness to full alertness – or leaving the 'dummy' state.

Squeezing for life

Madigan's squeeze technique was developed for use in foals with neonatal maladjustment syndrome and named after John Madigan in 2012 (Toth et al, 2012).

The technique, which is similar to a technique used for casting cattle (Bristol University, 2018), is a useful form of restraint for foals less than 3 days old, because they will lie down and fall into a deep sleep in response to pressure created by a long, soft rope, looped in a specific method around the neck, shoulders and chest of the foal and pulled steadily, making it useful for computed tomography scans, which were being conducted for research when the behaviour was observed. The technique can also be used for clinical procedures where keeping a foal still is invaluable, such as restraint for administration of plasma. When the pressure is released, the levels of sedating neurosteroids in the blood reduce substantially. Once the pressure is released from the rope, normal consciousness and behaviour returns, often quite rapidly, within a few minutes.

Madigan noted that, when applied to foals with neonatal maladjustment syndrome with a steady tension for 20 minutes, the squeeze technique mimics the parturition process and halts the production of neurosteroids that keep the foal quiet when in utero (Madigan, 2021).

Madigan's squeeze technique, which mimics stage 2 labour, has the potential to expedite the recovery process in affected foals and lessen the requirement for symptomatic and supportive treatment. After Madigan's squeeze technique is applied for 20 minutes, the results can be instantaneous – in successful cases, the foal gets to its feet, is bright and immediately recognises and bonds to its dam (Madigan, 2021). It is important to reiterate that the response is variable. While the results of the squeeze can be immediate, it is not always successful. Some foals will show no improvement at all and others may improve, but not fully.

Application station

The application of Madigan's squeeze technique typically involves the following steps:

1. Positioning: The foal is placed in a quiet and safe environment, either in a padded stall or a similar area with controlled surroundings. The mare should be kept close and within sight of the foal but restrained so she does not interfere or step on the foal.
2. Gentle pressure: A long, soft rope (veterinary casting rope or similar) with a loop in one end should be used. The loop is passed from the foal's withers, between the front legs and the tail of the rope threaded through (*Figure 1*). The rope is then passed around the foal's chest twice (*Figures 2* and *3*). The handler should check the rope is around the ribs and not the abdomen of the foal.
3. The rope is then steadily pulled in line with the foal's tail (caudally). This 'casting' technique is used on other rural animals (eg cattle) as well. The response to the rope tightening should be that the foal lies down. The pressure is applied evenly, targeting specific points on the foal's body, which mimic the natural pressure experienced during a normal birth process. The foal will lie down quickly and go into a deep sleep. Place a towel under the foal's head to protect the eye.
4. Squeezing and releasing: The practitioner gently and steadily squeezes the rope harness to apply pressure to the foal's body. This pressure imitates the pressure exerted by the birth canal during a normal birth. The pressure is held for a duration of 20 minutes to mimic parturition and then quietly released. The rope is then removed.
5. Observation during the squeeze: The foal's response to the squeezing is closely monitored. It is essential to ensure the

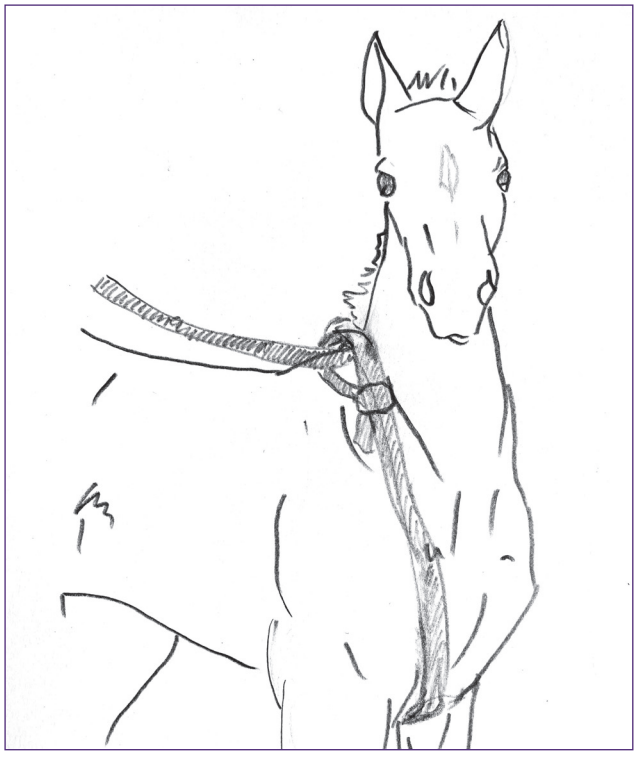

Figure 1. Stage 1 of applying the Madigan's squeeze technique.

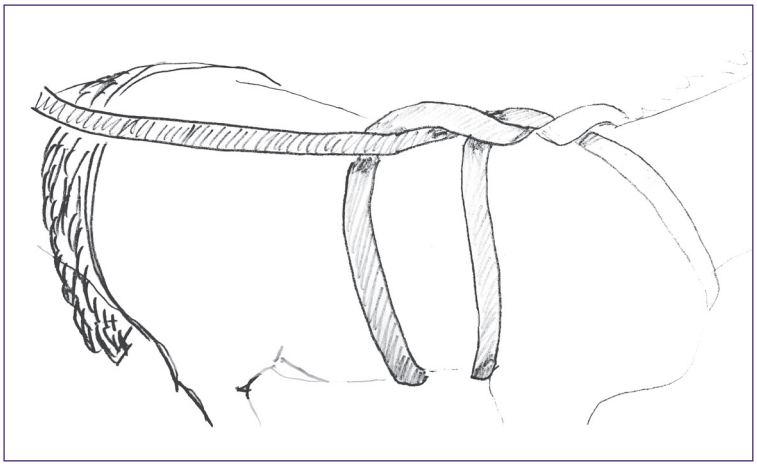

Figure 2. Stage 2 of applying the technique.

pressure is not excessive and that the foal does not show signs of distress.

6. The foal should continue to be observed once the ropes are removed but allowed to either continue lying down or to stand. The foal will wake up and should stand shortly thereafter (Fletcher, 2018).

Madigan's squeeze technique has been observed to be effective in many cases of neonatal maladjustment syndrome, helping foals recover and become more responsive shortly after application.

Although a successful outcome is around the same (80%) where Madigan's squeeze technique is used or not, the difference is that most foals treated with Madigan's squeeze technique do not need for further treatment and may show accelerated recovery. It is an elegant solution to minimising the cost of traditional supportive and symptomatic veterinary treatments, intravenous fluid therapy and intensive, 24-hour nursing care (Fletcher, 2018).

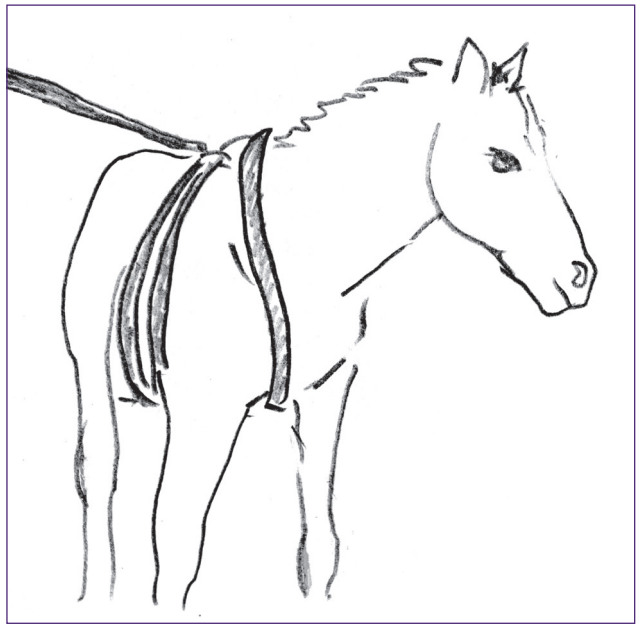

Figure 3. The completely wrapped foal.

Professional considerations and contraindications

Identifying and treating any additional health issues is crucial, as is providing suitable nursing interventions – Madigan's squeeze technique is not a silver bullet for all foal ailments.

The application of Madigan's squeeze technique should always be conducted under the supervision of a qualified veterinarian with experience in neonatal care because not all weakened foals have neonatal maladjustment syndrome (Aleman et al, 2017). Madigan's squeeze technique is contraindicated in some cases of neonatal maladjustment syndrome – for example, the foal could be adversely affected by the physical pressure during the squeeze procedure if it has fractured ribs or trauma, severe respiratory distress or underlying medical conditions (Holdsworth et al, 2022).

Foals with sepsis and other comorbidities may still have a favourable response to being squeezed but will need ancilliary veterinary and supportive treatment (EquiManagement, 2015).

Related research in other species

The application of Madigan's squeeze technique in other species, such as lambs and calves, has been recorded with similar successes. Neonatal maladjustment syndrome has similar clinical signs to 'weak calf syndrome' in calves (Wall, 2023) and can be observed in piglets and lambs with neonatal maladjustment syndrome as well. A similar improvement has been noted in these neonates as in foals (Flora et al, 2021; Holdsworth et al, 2022).

In humans, research is underway to explore the correlation between neurosteroid production and autism. The Madigan's squeeze technique with ropes is not suitable for use in human babies but it is comparable to swaddling. Researchers are exploring whether abnormal regulation of neurosteroids during the time around

childbirth could be one of many factors that may contribute to autism and related neurodevelopmental disorders. One study has reported elevated levels of neurosteroids in children with autism spectrum disorder (Bailey, 2015).

Conclusions

Madigan's squeeze technique is a valuable addition to the veterinary toolbox of interventions in managing neonatal maladjustment syndrome in foals. It stimulates a behavioural response to improve neurological function. Veterinary nurses should carefully apply this technique, considering the individual condition of each foal, and closely monitor for signs of responsiveness. It is not a universal solution, and contraindications, such as fractures or respiratory distress, must be taken into account. Collaboration with veterinarians is essential to ensure a tailored and safe approach. The technique's success contributes to the overall goal of enhancing the wellbeing of foals affected by neonatal maladjustment syndrome, underscoring the importance of a comprehensive and collaborative veterinary care approach. EQ

Conflicts of interest

The author declares that there are no conflicts of interest.

Further resources

- Instructions for application of Madigan's Squeeze Technique https://compneuro.vetmed.ucdavis.edu/sites/g/files/dgvnsk5376/files/inline-files/mfsm_instructions_0.pdf
- Application of the rope: https://www.youtube.com/watch?v=-oxGVrRzCYI

KEY POINTS

- Madigan's squeeze technique is used in cases of neonatal maladjustment syndrome in foals. It involves applying gentle manual pressure to the foal's head and body to stimulate a behavioural response, aiming to improve neurological function.
- While performing the squeeze, veterinary nurses should closely observe the foal for signs of responsiveness and improved neurological status. Monitoring includes assessing the foal's ability to stand, nurse and exhibit normal behaviours.
- The technique should be applied with consideration of the foal's specific condition and response, and adjustments may be needed based on the severity of the maladjustment syndrome and the foal's overall health.
- Veterinary nurses should be aware of contraindications that may make the squeeze technique inappropriate. Careful assessment and consultation with a veterinarian are crucial before applying the technique.
- Madigan's squeeze should be conducted in collaboration with a veterinarian to ensure the safety and wellbeing of the foal, and to determine the effectiveness of the technique in individual cases.

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