UNIVERSITY OF CALGARY
FACULTY OF VETERINARY MEDICINE

This review accompanies the relevant episode of the Cutting Edge veterinary podcast. In each episode of this podcast, 3rd year students in the University of Calgary's veterinary medicine program fill you in on the most up-to-date literature and evidence-based practices on topics that matter to you, the practising veterinarian.

When Would Flotation Therapy Be Most Beneficial in The Treatment Of Downer Cattle?

STUDENTS: Nyomi Brobbel and Faith Jensen
FACULTY MENTOR: Dr. Gordon Atkins

Downer Cow Syndrome

Downer cow syndrome refers to cows unable to rise for a period of time longer than 12-24 hours.[1] This syndrome occurs most commonly in periparturient dairy cattle at a prevalence of 1.1-2.1%.[2 3] Although milk fever is the most common cause of the condition, bone fractures, luxations, calving paralysis, and toxic mastitis or metritis are also frequent causes.[4] Regardless of the primary cause of recumbency, "in cows that are involuntarily recumbent for >24 hours, secondary damage should be not only considered but expected".[1] Bovine Secondary Recumbency (BSR) refers to the damage and pressure necrosis of appendicular muscles and nerves that develops following prolonged recumbency of cattle, often due to compartment syndrome.[1] This damage results from the animal's body weight placing pressure on muscles and nerves of the limbs, preventing return to ambulation following treatment of the primary insult. Renal failure can also occur secondary to myoglobinuria following significant muscle damage.[1]

Flotation Tank Set-Up

The use of flotation therapy has been used to both diagnose the primary cause of recumbency and treat BSR. Flotation therapy reduces the weight carried by affected muscle groups while removing the pressure placed on the limbs when the cow is lying down. In addition, the warm water has a therapeutic effect by increasing blood flow to the damaged muscles and by lifting the cow it can aid in the visualization of the cow's limbs for diagnosis of some musculoskeletal conditions. Flotation therapy looks different depending on if a portable or permanent tank is used. When a portable tank is used, the tank is pulled behind a truck and parked in front of the affected cow. A mat is placed next to the cow which the cow is then rolled onto. Together the cow and mat are winched up into the tank. Following this, doors are placed on the ends of the tank and the tank is moved to an appropriate location with good footing and that will allow for drainage of the tank. Once in an appropriate location, the tank is unhitched from the truck and the trailer assembly is disengaged, allowing the tank to settle on the ground. Finally warm water is added to the tank.[5] As the tank fills the cow's head is kept above the waterline by the use of a

halter but the rest of her body is pushed down to prevent her from trying to rise prematurely, which could result in traumatic injuries. Once the water level reaches the shoulder joint, the cow is allowed to rise and if needed additional slings can be used to keep the cow upright. It is estimated that when used properly flotation therapy results in a 90% reduction in the weight carried by the cows' damaged muscles.[6] This is accomplished by the buoyant forces of water in combination with the air filled viscera of the cow. If a permanent tank is used, the cow is transported to the tank via an overhead hoist and rail system attached to a rectangular platform which the cow is rolled onto.

Special Considerations

In each system the cow is floated for six to eight hours with access to feed via a trough attached to the front door of the tank. At the end of the flotation session the water is drained and the cow is forced to bear its full body weight. Prior to the cow walking out of the tank, she can be milked by removing the rear door. Ideally, the cow would also be milked 2-3 hours prior to flotation and a barrier teat dip applied.[7] The front door of the tank is then removed and the cow is allowed to exit very slowly. It is critical that during flotation and when exiting the tank, cows with hindlimb weakness wear hobbles on the rear limbs with at least 3 feet between limbs.[1] The area which the cow steps out of the tank onto must have both good footing and soft bedding to prevent the cow from falling while preventing injuries in the event the cow is unable to stand. Cows that fall upon exiting the tank should be placed back into the tank for a second flotation session. On average, three flotation sessions are required for cows to regain the ability to stand for prolonged periods of time as well as rise on their own.[6]

A major challenge of cattle floatation therapy is the acquisition of large quantities of warm water. The average flotation session will require 2400L of close to body temperature water.[8] This can be especially difficult in Alberta with the cold temperatures and relative water scarcity. Water must either be heated on farm or collected from another source prewarmed. In addition transporting the water will require an appropriate sized truck, usually a ¾ ton or larger, a water tank, and possibly a trailer. If a permanent floatation tank is used, a common option for storage of warm water is the use of milk bulk tanks that the dairy may already have or can acquire easily. Common sources of warm water include cement and milk processing plants. One study found that water temperature is well maintained throughout flotation sessions if the tank is kept in a barn out of the elements. The water temperature dropped by around 4 degrees from an average of 31 degrees down to 27 degrees with only the cow's body heat to maintain that temperature.[8] During cold times of the year tarps can be placed over the tank and cow to help maintain the water temperature.

Prognostic Indicators

Prognostic indicators aid in a veterinarian’s decision to implement the use of a flotation tank in the treatment of BSR. The first prognostic indicators a veterinarian can use immediately on farm

include temperature, pulse, and respiration. Tachycardia in downer cows is associated with a poor prognosis with one study finding that cows with a heart rate over 100 beats per minute (BPM) were 3.7 times more likely to have a negative outcome than cows with a lower heart rate.[9] In that case, a negative outcome was defined as death, euthanasia, or being culled from the herd 7 days after enrollment in the study. A second study indicated that downer cattle with a heart rate of 100-120 BPM were 1.93 times more likely to be euthanized or die than downer cattle with a normal heart rate of 60-80 BPM and that value jumped to 2.92 times more likely to be euthanized or die when their heart rate was above 120 BPM.[2] This second study also investigated temperature and respiration as prognostic indicators. The investigators found that downer cows with a respiratory rate of greater than 36 respirations per minute (RPM) were 1.76 times more likely to be euthanized or die than downer cows with a normal respiratory rate of 12-36 RPM.[2] Hypothermia, defined as a temperature of less than 38.2 degrees Celsius, made downer cows 2.08 times more likely to be euthanized or die than down cows with a normal temperature of 38.2-39.2 degrees Celsius.[2] Hyperthermia may also be indicative of a primary cause of downer cow syndrome such as mastitis, metritis, pneumonia, or peritonitis.[2]

Additional values a veterinarian can assess to determine the prognosis of an individual downer cow includes a complete blood count and certain blood chemistry values including neutrophil and red blood cell counts as well as CK, AST, and creatinine values. In the first study mentioned, cows with a neutropenia of <1100 cells/microlitre were 2.5 times more likely to be euthanized or die than other cows while cows with a hematocrit <26% were 3.3 times more likely to die or be euthanized. In the same study cows with creatinine values >116 mmol/L were 1.75 times more likely to be euthanized or die. CK and AST values are especially important in BSR as they can be indicators of muscle damage.[2] Another study found that CK starts to increase after 12 hours of recumbency and continues to increase for the first 48 hours after which it will begin to decrease. AST, however, was found to be increased on days 4-7, after CK values had decreased. Elevated CK values were only found to be significantly higher in downer cows compared to cows that were able to rise following anesthesia after 48-96 hours of recumbency.[10]As a result, duration of recumbency must be considered when assessing CK and AST values in downer cows. In the first study mentioned, cows with AST values of 500-1000U/L were 2.16 times more likely to be euthanized or die and cows with AST values >1000 U/L were 6.69 times more likely be euthanized or die compared to those with AST values <500 U/L.[2] In a separate study AST was found to be more useful as a prognostic indicator than CK because it found that CK was not significantly different between the control and study groups at the time of admission to hospital.[11]

Response to flotation tank treatment both during and after treatment can be an important indicator of prognosis. An in-hospital study found that cattle which walked backward out of the flotation tank and into their stall once they completed their first flotation were 4.8 times more likely to survive than cattle that fell or could not stand following their first flotation.[11] Providing forage to the cow during the flotation treatment is useful as it can indicate to the veterinarian prognosis for survival as well, with cattle that eat during the treatment being 1.9 times more likely to survive.[11] Downer cows that were able to stand apparently normally on all four limbs during flotation, as opposed to those with an asymmetric stance or those unable to stand, were

2.9 times more likely to survive.[11] Therefore, when performing a flotation if the cow needs a belt to support them and help them stand during flotation it may indicate a worse prognosis.

Criteria for Flotation Therapy

Flotation therapy can be a successful treatment strategy when patients are triaged based on a specific set of criteria to determine if flotation therapy will be useful. These criteria include a complete physical examination, absence of terminal musculoskeletal conditions, and identification and treatment of all metabolic imbalances before flotation therapy. Prior to the physical examination, signalment and relevant history is obtained. Areas of emphasis in the complete physical examination include distant examination, evaluation of TPR (temperature, pulse, and respirations), transrectal palpation, evaluation for mastitis, and reproductive tract evaluation. Upon distant examination, cows that are down and unable to maintain sternal recumbency should be excluded from flotation therapy.[8] Distant examination may also indicate altered mentation which can be a result of toxemia, a primary cause of downer cow syndrome.[1] As discussed earlier, TPR during a physical examination can provide important information about prognosis when determining whether flotation therapy will be successful. When combined with hydration status, pulse strength, jugular fill, and capillary refill time, it can indicate the presence of hypovolemic shock which also provides a worse prognosis.[1] Transrectal palpation should be performed to evaluate for musculoskeletal injury including fractures, swellings, or dislocations of the pelvis that will make flotation therapy unadvisable. Transrectal palpation will also determine the presence of an acute abdomen, signs of peritonitis, or reproductive tract abnormalities.[1] The teats and udders should be examined carefully and a California Mastitis Test should also be performed to look for evidence of toxic mastitis, a primary cause of downer cow syndrome. Reproductive tract evaluation via transrectal palpation and vaginal exploration is required, especially in periparturient cows, to determine if metritis and associated toxemia is present which is also a primary cause of downer cow syndrome.[1]

Absence of terminal musculoskeletal conditions is determined by a complete musculoskeletal examination. Terminal musculoskeletal conditions that would make the cow ineligible to receive flotation therapy treatment include, but are not limited to: fractures of the limbs or spine, coxofemoral luxations, ruptured gastrocnemius muscle, and a ruptured peroneus tertius muscle.[8] The spine should be palpated from neck to tail to identify swellings, areas of pain, and instability and all four limbs should be individually palpated to assess for joint mobility, areas of pain, swellings, reflexes, and open lesions.[1] Attempts to rise by the cow can be evaluated for abnormal weight bearing, positioning, and posture of a limb to locate musculoskeletal or nerve lesions.[1]

Identification and treatment of metabolic imbalances before flotation therapy is an asset because it treats the primary cause of recumbency. This makes treatment of BSR with flotation therapy more likely to be successful as the cow will not go down again due to the primary cause of recumbency leading to a re-occurrence of BSR. Most commonly, hypocalcemia is the metabolic imbalance associated with downer cow syndrome, but other metabolic imbalances including hypokalemia or hypophosphatemia can occur.[1] Identification of a metabolic disorder

such as hypocalcemia and definitive diagnosis can be difficult as laboratory testing is not always available when the veterinarian is out in the field. Physical examination becomes extremely important in these cases. With hypocalcemia, on physical examination a veterinarian may find important clinical signs leading to a field diagnosis of hypocalcemia when laboratory testing is unavailable including: tachycardia that can reach over 120 beats per minute in severe cases, weak peripheral pulses, muscle flaccidity, absence of a pupillary light response, ruminal tympany, and sternal recumbency that can progress to lateral recumbency.[12] Once diagnosed with hypocalcemia, it is important to treat as soon as possible with one study finding that 98.8% of recumbent hypocalcemic cows treated for their hypocalcemia within 6 hours of becoming recumbent became ambulatory and had an improved prognosis compared to cows that were down longer than 6 hours prior to treatment due to development of BSR.[13]

References

1. Grunberg W. Bovine secondary recumbency - musculoskeletal system [Internet]. Merck Veterinary Manual; 2023 [cited 2023Feb22]. Available from: https://www.merckvetmanual.com/musculoskeletal-system/bovine-secondary-recumbency/bovine-secondary-recumbency

2. Puerto-Parada M, Bilodeau MÈ, Francoz D, Desrochers A, Nichols S, Babkine M, et al. Survival and prognostic indicators in Downer Dairy Cows presented to a referring hospital: A retrospective study (1318 cases). Journal of Veterinary Internal Medicine. 2021;35(5):2534–43.

3. Cox VS. Nonsystemic causes of the Downer Cow Syndrome. Veterinary Clinics of North America: Food Animal Practice. 1988l;4(2):413–33.

4. Kalaitzakis E, Panousis N, Roubies N, Giadinis N, Kaldrymidou E, Georgiadis M, Karatzias H. Clinicopathological evaluation of downer dairy cows with fatty liver. Can Vet J. 2010 Jun;51(6):615-22.

5. Aqua Cow Rise System Danmark. [Internet]. Aqua Cow Rise System. [cited 2023Feb23]. Available from: https://www.aquacowsystem.com/wp-content/uploads/2021/03/Aqua-Cow-Rise-System.pdf

6. Atkins G.Floatation tank saves downer cows. Hoards Dairyman. 2002.

7. Van MDC, St. JG, Vestweber J. Flotation therapy for Downer Cows. Kansas Agricultural Experiment Station Research Reports. 1996;(2):38–41.

8. Stojkov J, Weary DM, von Keyserlingk MAG. Nonambulatory cows: Duration of recumbency and quality of nursing care affect outcome of flotation therapy. Journal of Dairy Science. 2016;99(3):2076–85.

9. Labonté J, Dubuc J, Roy J-P, Buczinski S. Prognostic value of cardiac troponin I and L-lactate in blood of dairy cows affected by Downer Cow Syndrome. Journal of Veterinary Internal Medicine. 2017;32(1):484–90.

10. Smith BP, Angelos J, George LW, Fecteau G, Angelos S, Hullinger P, et al. Down Cows: Causes and Treatments. AMERICAN ASSOCIATION OF BOVINE PRACTITIONERS CONFERENCE PROCEEDINGS. 1997;43–45.

11. Burton AJ, Nydam DV, Ollivett TL, Divers TJ. Prognostic indicators for nonambulatory cattle treated by use of a flotation tank system in a referral hospital: 51 cases (1997–2008). Journal of the American Veterinary Medical Association. 2009May1;234(9):1177–82.

12. Oetzel GR. Parturient paresis in cows - metabolic disorders [Internet]. 2023 [cited 2023Feb27]. Available from: https://www.merckvetmanual.com/metabolic-disorders/disorders-of-calcium-metabolism/parturient-paresis-in-cows

13. Stull CL, Payne MA, Berry SL, Reynolds JP. A review of the causes, prevention, and welfare of Nonambulatory cattle. Journal of the American Veterinary Medical Association. 2007Jul15;231(2):227–34.