For Vet Professionals only

Face2Vet

A Clinical Update

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THE DOWNER COW - DIAGNOSIS AND MANAGEMENT

Downer cow syndrome is one of the most critical production disease recorded in lactating dairy animals during peripartum period (2-3 weeks before and after parturition). It causes severe economic losses in terms of heavy reduction in milk yield and impaired reproductive performance. It is defined as an alert cow that could not stand up for 24 hours or more. Other definitions include all non-ambulatory cattle (alert or non-alert) that are unable to stand for any duration of time without assistance.

Alert downers are more or less active showing normal appetite, defecation and urination and normal body temperature. They usually positioned as sternal recumbency, crawling with forelimbs to get up but could not raise the hind part. The non-alert downers are somewhat critical and are in lateral recumbent position and there is complete loss of appetite, dull and depression. Due to continuous pressure on floor, non-alert downers develop several wounds over knees, shoulders, hocks, tuber coxae and thigh region.

Hypocalcaemia is the most common cause of downer cow syndrome. Injuries, muscle damage, mineral deficiency, toxic mastitis, metritis, etc. are also common factors responsible for causing the syndrome. Cattle with extreme acidosis can also progress to depression, dehydration, toxaemia and downer cow syndrome. Most studies on periparturient conditions are focused on large animals which are reared in intensive farming. Downer cow syndrome can be characterized by:

- Prolonged recumbency even after two successive Calcium therapies
- Recumbent at least for 24 hours without any apparent reason
- Traumatic injury to limb muscles and nerves
- Ischemic necrosis of limb muscles
- Myocarditis
- Fatty infiltration and liver degeneration

Fig. 1: Sternal recumbency with right lateral kink

Etiology

Most commonly, downer cow is a complication of milk fever. It is result of muscular injury due to too much confinement in byre, obesity, over feeding during dry period and too much compression of limbs. Cows having ischemic necrosis of major muscles of pelvic limbs, injuries to obturator muscles and lesions to tissues around hip joint are unable to stand and recover fully but instead remain recumbent.

- **As a complication of persistent hypocalcaemia:** Downer cows may remain refractory to calcium treatment. The calcium depletion may arise owing to reduced calcium resorption from digestive tract due to poor appetite.
- **Persistent hypophosphatemia:** There is low level of phosphorus but actual reason for low phosphorus is not obvious. General tiredness is observed in animals with low phosphorus level.
- **Hypomagnesemia (lactation tetany or grass tetany):** Occurs as a complication of hypocalcaemia in recently parturated animals. Magnesium deficiency is associated with hyperaesthesia.
- **Hypokalaemia** with hypophosphatemia is a typical manifestation in creeper cow (alert, bright, crawl around but couldn't raise).

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- **Traumatic injuries**: Injuries of muscles especially medial thigh muscle. Rupture of gastrocnemius tissues around hip joint muscle, obturator muscles, abductor muscles and tendon spread-eagling of hind legs.
- **Traumatic injuries to nerves**: Caused due to over stretching of nerves or pressure on nerves of the limbs *viz*. sciatic, obturator, radial, peroneus, tibial, etc.
- **Myocardosis**: The damage of heart muscle may be attributable to repeated dosing with Calcium preparations in milk fever condition.
- **Dystocia**: Dystocia due to an oversized calf may result in extensive oedema of pelvic tissues and vulva, and failure of cow to stand following parturition. If these cows develop milk fever, it is unlikely they will be able to stand following treatment with Calcium. Calving paralysis from nerve injury after dystocia, may also result in prolonged involuntary recumbency.
- **Hepatosis:** Well-fed highly obesed cows during late pregnancy very often suffer from fat cow syndrome which predispose to downer condition.
- **Septic mastitis:** A cow may show paralytic syndrome due to acute mastitis caused by *E. coli* and *S. aureus.*
- **Serum electrolyte imbalance:** Serum electrolyte imbalance may be responsible for prolonged recumbency.
- **Toxaemia:** Toxaemia in per acute or acute mastitis, acute diffuse peritonitis, uterine rupture, aspiration pneumonia, traumatic reticulitis / pericarditis.
- **Management causes:** Malnutrition, over fat, slippery floors and epidural anaesthesia.

Incidence

- The incidence as a complication of milk fever is high because many affected animals are high producers and of high economic value. The incidence of downer cow syndrome, is estimated between 1.1 and 2.1 downer cows per 100 cow years at risk.
- Jersey crossbred cows of 4-5 years age group have highest incidence of recumbent cow syndrome. Recumbent cow incidence of 7.39 percent of various diseases found at Veterinary College and Research Institute (VCRI), TANUVAS, Namakkal during June 2015 to May 2019. Among which Jersey crossbred cattle had highest (58.99 percent) incidence of recumbent cow syndrome followed by Holstein Friesian cattle (34.84 percent). Highest incidence of recumbent cow syndrome was noticed in 4 -5 years age group (23.92 percent) followed by 3-4 years (18.71 percent) and 2-3 years (16.91 percent). Periparturient animals (59.71 percent) had highest incidence of recumbent cow syndrome as compared to pregnant (23.02 percent) and lactating cows (17.27 percent).
- Reports suggest that downer cows are high producers (48 percent) and approximately 58 per cent of cases occurred within one day of parturition and 37 percent occurred during first 100 days of lactation.
- In a clinical and laboratory survey of 433 periparturient recumbent cows in New Zealand, 39 percent recovered, 30 percent died and 32 percent were sacrificed. The prevalence of downers due to metabolic, digestive, infectious, musculoskeletal and nerve injuries was 8.1 percent, 6.9 percent, 5.4 percent, 2.3 percent and 1.9 percent, respectively.

Epidemiology

The disease occurs most commonly within first 2 or 3 days after calving in high-producing dairy cows immediately following milk fever. Downer cows can be divided generally into non-ambulatory cows with non-progressive neurological findings and non-ambulatory with progressive neurological findings indicative of the presence of lesions in the nervous system as the cause of recumbency.

- Common during peak lactation years of high producers.
- It is a complication arising due to delayed or incomplete treatment of other diseases after parturition.
- Poor housing conditions, excess body fat, septic conditions and malnutrition may act as predisposing factors.

Risk Factors

Complications of Milk Fever

- Prolonged recumbency after a long delay in treatment of milk fever is a major risk factor.
- Prolonged recumbency before treatment for milk fever (more than 4-6 hours) results in ischemic necrosis due to obstruction of blood supply, especially in heavy cow if she lies on one leg for long period.
- The incidences of downer cow syndrome that is associated with milk fever ranges from 3.8-28.2 percent of all milk fever cases.

Traumatic Injuries to Pelvis and Pelvic Limbs

- Traumatic injuries to bones, muscles and nerves can be directly related to parturition (e.g. calving paralysis), be associated with muscle weakness and an insecure gait.
- Calving paralysis refers to a paresis or paralysis of one or both hind limbs caused by a lesion of obturator nerve and/or lumbar root of sciatic nerve inflicted during the calving process.
- Calving paralysis is considered the most common cause for persistent recumbency in cattle.

Electrolyte Imbalances

- Conditions like hypocalcaemia, hypophosphatemia, hypokalaemia and hypomagnesemia have been incriminated as potential factors contributing to downer cow syndrome.
- Hypophosphatemia is a common finding in recumbent but also in healthy periparturient cows.
- It is mineral imbalance most commonly quoted as risk factor, especially in so called creeper cows, which are bright and alert and crawl around, but are unable to rise.
- Hypomagnesemia along with hypocalcaemia is considered as major risk factor for downers cow syndrome.
- Severe hypokalaemia (serum potassium concentrations below 2.0 mmol/L) in cattle is associated with signs of depression and profound skeletal muscle weakness leading to recumbency.

Managemental Risk Factors

- A slippery ground surface is a major risk factor during calving period. There are chances of slip and fall and also injury to large muscles of pelvic limbs, resulting in inability to stand.

Other Factors

- Age and stage of lactation is a major risk factor for recumbency. Cows that are older and earlier in lactation are more likely to be recumbent because of hypocalcaemia as primary or contributing cause.
- Cows that are down for less than 24 hours will get recovered in certain extent, whereas cows recumbent for longer periods having less chance of recovery.
- A high body condition score (BCS) is a recognized risk factor for milk fever and therefore must also be considered as predisposing for downer cow syndrome.

Clinical Signs

- Some animals make no effort to rise. Others will make frequent attempts to stand but are unable to fully extend their pelvic limbs and lift their hind quarters more than 20 to 30 cm from ground.
- Those cows that do not make an effort to stand usually cannot stand even with assistance and if supported with cow slings, they will usually make no effort to bear weight with either hind limbs or forelimbs.
- Affected cows are usually bright and alert with good or only mildly depressed feed intake and are thus classified as alert downer cows.

Fig. 2: Creeper cow

- Appetite, defecation and urination are normal but proteinuria is common and may indicate extensive muscle damage.
- Temperature is usually normal but may turn towards sub-normal range in terminal stage of disease and heart rate may be normal or elevated to 80- 100 bpm.
- Tachycardia and arrhythmia occur in some cows, especially immediately following the administration of IV calcium and sudden death may occur.
- The affected cow usually crawls around utilizing forelimbs whereas hind limbs remain in flexed position. This type of stance is ascribed as "creeper cow"(Fig. 2).
- Respiration is not affected.
- Their limbs appear stiff, painful or numb and they are unable or reluctant to bear weight.
- Damage to peroneal nerve is usually present when there is hyperflexion of fetlock joints, which is evident if and when the cow is able to stand and bear weight on hind limbs.
- In some cases, hind legs are extended on each side (Fig. 3) and reach up to elbow joint (due to dislocation of hip joint or traumatic injuries surrounding hip with or without rupture of ligaments).

- In this position, cow is bearing considerable weight on medial thigh musculature and causing ischemic myopathy.
- Some cases having tendency to lie in lateral recumbency with head drawn back.
- More severe cases are hyperaesthetic, and limbs may be slightly stiff, but only when the cow is lying in lateral recumbency. Animals with this condition usually do not eat or drink and are described as non-alert downers.
- Coliform mastitis, decubitus ulceration, especially over prominences of hock and elbow joint and traumatic injuries around tuber coxae caused by hip slings are common.
- Death may occur within 48-72 hours following onset and is usually associated with myocarditis.

Fig. 3: Bilateral extension of hind legs

Pathogenesis

- In most cases, downer cow syndrome is a complication of an unrelated primary problem causing muscle weakness or persistent recumbency.
- Prolonged recumbency will result in secondary damage from excessive pressure on limbs squeezed between body and ground or from struggling to get up.
- Secondary damage can affect muscles, nerves, or other structural components such as bones or joints. Regardless of initial cause, prolonged recumbency results in varying degrees of pressure damage predominantly affecting the hind limbs.
- Based on results of experimental studies, it has been suggested that 6 hours of recumbency is the time threshold, beyond which tissue damage as a result of excessive weight bearing must be expected.
- This underscores the importance of handling any persistently recumbent cow as a medical emergency.
- Pressure damage in recumbent cattle primarily occurs in the major muscles of hind limbs, particularly semitendinous muscle, muscles caudal to the stifle and peripheral sciatic nerve and its branches.
- The local tissue damage is referred to as **compartment syndrome**; systemic effects resulting from local tissue damage are summarized so-called **crush syndrome**.
- A compartment (muscle and nerves of the limbs) get pressurised between the weight of body and rigidity of the ground on which cow is lying.
- This pressure on limb directly translates into increased pressure within affected compartment and will result in partial or complete occlusion of blood flow to muscles and nerves.
- Impaired blood supply to muscles and nerves and ensuing tissue hypoxia will add to direct damage from mechanical compression.
- Crush syndrome refers to the sum of systemic effects of extensive muscle tissue injury and is attributed to massive release of muscle-tissue breakdown products into blood circulation.
- Haematological examination - normal as in recently calved.
- Serum creatine phosphokinase that is CPK level increased along with aspartate aminotransferase (AST).
- There may be moderate ketonuria.
- Proteinuria and brown colour turbid urine in severe cases due to myoglobinuria, which is indicative of crush syndrome.
- Acute focal myocarditis occurs in about 10 percent of cases, resulting in tachycardia, arrhythmia and the unfavourable response to IV calcium salts observed in some cases.
- Prolonged recumbency can result in additional complications, such as acute mastitis, decubitus ulcers, and traumatic injuries of the limbs.

Clinical Pathology

- Serum glucose concentration is in normal range, but calcium, phosphorus and potassium level may be decreased in cows with depressed feed intake and increased muscle damage.
- The serum activity of AST is usually markedly elevated by 18-24 hours after onset of recumbency.
- Muscle tissue is rich in creatine kinase (CK) and the plasma half-life of this enzyme in cattle is only about 8 to 9 hours.
- This high CK in serum declines markedly after 24-48 hours of recumbency is an indicative of acute muscle damage.

- Cows with a serum urea level above 25 mmol/L and serum creatinine levels above 130 mmol/L had a poor prognosis.

Necropsy Findings

- The major pathologic changes consist of haemorrhage and degeneration of thigh muscles and haemorrhage around hip joint.
- Local areas of ischemic necrosis of the musculature (gracilis, pectineus and adductor muscles) occur at anterior edge of pelvic symphysis.
- Edema and hemorrhages on the nerves of limbs (obturator, sciatic, peroneal, radial) are also common and usually associated with severe muscle damage.
- Heart is dilated and flabby. Histopathology shows focal myocarditis.
- Fatty degeneration of liver.
- Adrenal glands enlarged.

Diagnosis

- History of long time recumbency.
- Thorough clinical findings.
- Physical examination.
- Serum biochemical analysis, urinalysis.
- Determining the biochemical status of cattle unresponsive to calcium therapy in particular will help to guide treatment and prognosis.
- Hypokalaemia and hypophosphatemia have been suggested as potential causes for downer cow syndrome in cows with normal mentation.
- Examination of fresh urine may reveal a dark discoloration consistent with myoglobinuria, resulting from the excretion of large amounts of myoglobin through the kidney after severe muscle damage.
- Downer cows commonly have increased serum lactate dehydrogenase (LDH) activity to a varying extent, which may indicate the presence and severity of muscle trauma.
- Increased serum CK activity is a specific indicator of muscle damage. CK activity peaks shortly after the start of muscle damage but declines noticeably within four hours because of the short half-life of this enzyme.
- AST activity is most suitable prognostic indicator in recumbent cattle, with higher AST activity indicating a poorer prognosis.

Differential Diagnosis

- **Diseases of bones**: Osteoporosis in which bone becomes weak due to increased bone resorption and osteomalacia is a mineral deficiency disease that occurs in many animal species and is associated with failure in bone tissue mineralization. Osteomalacia is usually caused by dietary phosphorus (P) deficiency in case of large animals like cattle and buffalo. Animal will respond to phosphorus therapy.
- **Diseases of joints**: Acute arthritis especially hip joint in which there is pain on movement. Animal will respond to anti-inflammatory treatment.
- **Foot diseases**: Laminitis is inflammation and damage of the tissue between hoof and underlying coffin bone, fissured feet caused due to environmental factors, dry conditions and nutritional disturbances. In foot diseases, animal shows lameness instead of recumbency.
- **Peripheral nerve paralysis**: If the femoral nerve is injured, the affected cow cannot extend the stifle joint, bear weight or extend the affected leg. Obturator nerve paralysis develops from pressure on the obturator nerve during parturition, which prevents ability to adduct thighs while cow is in a recumbent position. Animal will respond to nervine tonics.
- **Milk fever**: There is subnormal rectal temperature, animal is sitting on sternum, head rest on flank region, tremors in hind limb muscles, crushing of teeth, muzzle is dry, etc. Animal will respond to calcium therapy within one hour of intravenous calcium injection.
- **Hypophosphatemia**: Animals suffers from anorexia, haemoglobinuria, constipation and pica. Animal will not be recumbent at initial stage. It will respond to phosphorus therapy within two days.
- **Hypomagnesaemia**: No recumbency, staggering gait, frothing at mouth, champing of jaws and rise in temperature up to 104-105 ^{0}F, muscle tremor, etc.

- **Ketosis**: Recumbency is observed only in case of ketosis complication with milk fever. Ketone bodies are found in the urine examination. Sweetish smell from animal's mouth. Animal will respond to glucose therapy.
- **Paralytic myoglobinuria**: Disease of horse, occurring during exercise after a period of rest on full ration. Urine is red or coffee coloured due to presence of myoglobin. Temperature may rise to 105 ^{0}F.
- **Rickets**: Occurs in young animals. Bowing of legs, pain or tenderness in the bones of the arms, legs, pelvis or spine, stunted growth, short stature, bone fractures, muscle cramps, etc. are the symptoms of rickets. Animal slowly respond to calcium therapy.
- **Poisoning**: Poisoning leads to diarrhoea, bleeding from gut, convulsions, abnormal heart rhythm, cyanotic mucus membranes, etc. Animal will respond to particular antidote and charcoal therapy.
- **Others**: Weakness, ephemeral fever, acidosis, foreign body, pneumonia, heat stroke, trauma, dislocation, ruptures of ligaments and muscles, calving injury, metritis, damage to spinal cord, rupture of uterus, etc.

Prognosis

- The wide array of primary causes and the range in severity of secondary nerve and muscle damage make it challenging to provide a prognosis for non-ambulatory cattle.
- Cases which stands up within 6 hours after treatment having good prognosis.
- Some cases with the findings of fractures, swollen limbs, extensive muscle damage or nerve damage are suggestive of poor prognosis.
- In downer cow syndrome about 20-67 percent mortality is observed.
- Many cases die within 7-10 days due to sepsis or shock.

Treatment

Downer cow is a disease condition which is always associated with hypocalcaemia. Treatment of a non-ambulatory cow evidently must focus on primary cause of recumbency whenever it has been identified, but must also address secondary damage resulting from prolonged recumbency. Intensive supportive care is required for treatment of secondary damage and prevention of further damage. The prognosis of a downer cow not only depends on the initial cause of recumbency but to a large part also on the quality of care provided during the recumbent period.

Fig. 4: Cow lifting device

General Care

- **Comfortable bedding:** Provide comfortable bedding to roll the cow from side to side several times daily to minimize the extent of ischemic damage and para-analgesia that results from prolonged recumbency. A sand or dirt pack is ideal ground surface to facilitate standing when downer cows attempt to stand.
- **Non slippery ground surface:** If affected cows are left on a slippery ground surface, they will not make an effort to stand and will become progressively worse.
- **Lifting devices:** Different lifting devices available are Danish aqua lift and power cow cradle, hip lifters, inflatable balloons, different types of slings, flotation therapy, etc. Slings can be applied and the animal lifted to standing position (Fig. 4). If animal bears weight on all four legs, she should be allowed to stand with the aid of device for 20 to 30 minutes and then lowered down. This procedure can be repeated once or twice a day, provided cow is able to support her own weight while standing.
- **Assisted lifting to stand:** If the cow makes an effort to stand on her own, she should be assisted to stand by ensuring a good nonslip ground surface, providing deep bedding and lifting up on the tailhead when she attempts to stand. Lifting cows that make no effort to stand on their own is usually unsuccessful. When lifted, they usually do not bear any significant weight.
- **Management of non-ambulatory cows:** More recently, water flotation tanks have been used for the management of non-ambulatory cows. Proposed devices consist of a watertight metal tub with inside dimensions of approximately 234 cm long, 109 cm wide and 130 cm high. The system can be mobile and although the use is labor intensive, it can give good results when selecting suitable patients judiciously.

Therapeutic Management

- Injection of Calcium borogluconate and Magnesium salts @ 1 ml/kg b.wt. slow IV, Phosphorus injection- **Inj. NOVIZAC** @ 25 ml reconstituted solution on 1st day and 25 ml on 2nd day by IM, IV or SC route.
- To avoid milk fever, administer Calcium levulinate and Vitamin D_3 preparation (**Inj. Intacal-IM) @** 10-15 ml thrice in a week, IM only.
- Corticosteroids to stimulate gluconeogenesis Inj. Dexamethasone @ 0.04 mg/kg b.wt. IV or Isoflupredone @ 0.02 mg/kg b.wt. IM (**Inj. INEROL** @ 0.02 mg/kg b.wt. IM).
- Broad spectrum antibiotic for septic conditions: **Inj. AC-VET MAX** @ 6-10mg/kg b.wt. IM/IV.
- Anti-inflammatory: Pain in cattle, as in other species, can occur as a result of tissue damage, nerve damage and inflammation, all factors considered to greatly contribute to downer cow syndrome. Tolfenamic acid (**Inj. MAXXTOL**) @ 4 mg/kg as a single dose IM or IV early in the recumbent period has been advocated by some clinicians, based on clinical experience, to control and contain inflammatory neuropathy resulting from trauma or pressure.
- Nervine tonics: Inj. **TRIBIVET M** should be administered @ 5-10 ml IM or IV to overcome neuro-muscular disorders, nervine weakness and recumbency along with Tribivet oral @ 100 ml daily as an adjunct.
- Fluid therapy: Fluid and electrolyte therapy orally and if necessary parenterally is indicated in patients with inadequate water and feed intake. Multiple electrolytes can be added to drinking water if the cow is drinking normally. The supplementation of minerals such as phosphorus, magnesium, or potassium has been advocated, but they have been used without consistent success. **Inj. Intalyte** @ 500-2000 ml IV should be given as fluid and electrolyte replacement.
- Stimulant or energy tonics like **E-Booster** can be given @200 ml orally twice daily, to overcome negative energy balance.
- Solutions containing Ca, P, Mg, Vit. D_3 and B_{12} (**Calrize** @ 300 gm orally before and after parturition) for providing energy after the parturition.
- Vitamin E and Selenium supplement should be given along with potassium.

Control Measures

- Measures should be taken to prevent milk fever. Early detection and treatment of milk fever will reduce the incidence and severity of downer cow syndrome. Cows with milk fever should be well bedded with liberal quantities of straw or moved to a soft-ground surface.
- Provide nutritious diet containing green fodder, dry fodder along with mineral supplements to avoid metabolic diseases.
- Prevention of mastitis: *E. coli* and Klebsiella are examples of coliform bacteria found in manure and bedding materials. Mastitis conditions resulting from infection by these organisms can cause severe toxaemia and weakness of cow, often resulting in downer cow problems.
- Recumbent cows should be coaxed and assisted to stand if possible after treatment for milk fever.
- If they are unable to stand, they should be rolled from one side to the other every few hours, to minimize the ischemic necrosis.
- Avoid moving pregnant cows too late to calving area.
- Prevention of calving injury – calving paralysis results from damage to the obturator nerve during calving. It should be avoided by providing good management and monitoring calving process.
- Avoid lateral recumbency by placing bales of straw, to prevent hydrostatic congestion and ruminal tympany.
- Protection from the elements is essential. Rain and wind can decrease body temperature considerably and worsen shock if present.
- Be sympathetic to the animal: Provide safe footing in alleyways, barnyards, laneways and milking parlours. Non-slip flooring is essential to prevent falls, which can result in fractures, injuries or crippling spreader injuries.

Anionic feed supplementation for hypocalcaemia prevention

- Over the last few years concept of using Dietary Cation Anion Balance (DCAB) has been developed to prevent hypocalcaemia. Cations like sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) have a positive charge. These cations in the diet promote a more alkaline (higher blood pH) metabolic state

which has been associated with an increased incidence of milk fever. Anions like chloride (Cl), sulfur (S) and phosphorus (P) have a negative charge. Anions promote a more acidic metabolic state (lower blood pH) that is associated with a reduced incidence of milk fever.

- When the balance between cations and anions results in net negative charge (negative DCAB), the blood pH is lowered. To neutralize lower blood pH, cow adjusts pH by buffering the acidic condition.
- Reduced urinary pH also increases Ca excretion via urine which in turn lowers the blood calcium level and works as a negative feedback signal for the parathyroid gland to secrete parathyroid hormone (PTH) to maintain blood calcium level by mobilization of calcium from bone.
- Metabolic acidosis induced by an excess of absorbable anions (negative DCAB) enhances PTH activity which augments Ca mobilization from labile bone; additionally, PTH also stimulates renal Vitamin D which is resulting in greater efficiency of intestinal Ca absorption. By the above mechanism negative DCAB reduces the incidence of milk fever.
- **Hyporid and Intabolite** have been developed considering the negative DCAB and assist in hypocalcaemia management and prevention of cows with prior history of hypocalcaemia in last calving or even with higher post-partum complications.

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