An Update on the Downer Cow Syndrome

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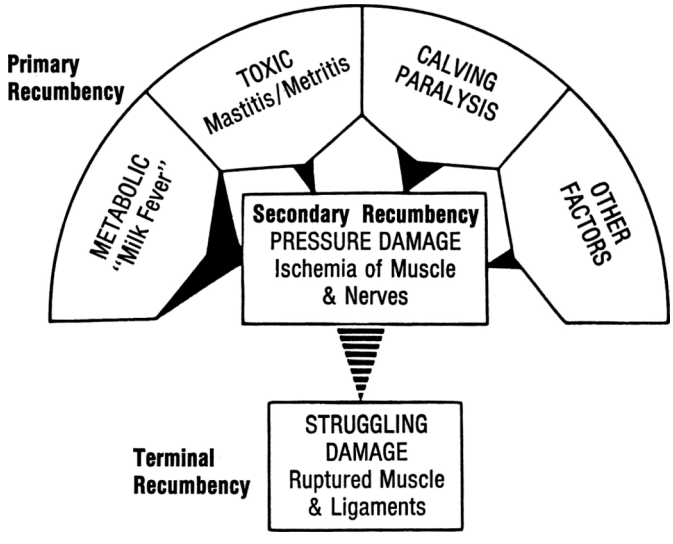
The general term "downer" has been in use for a long time. It appeared in print as early as 1905 when Upton Sinclair used it to describe debilitated cattle of Chicago slaughter houses in his classic book, *The Jungle.* The more specific term, downer cow, appeared in the veterinary literature in 1955[17 26] followed by creeper cow in 1962.[18] While the general term can refer to any animal that is unable to rise, the more specific term, downer cow, usually refers to a periparturient cow that is in prolonged sternal recumbency and the reason for the recumbency is paradoxical.[1 4 8 10 11 14 19 25] An atypical nonalert downer in lateral recumbency has also been described.[15] A recent survey of Minnesota DHIA herds found an incidence of 21 typical cases/1,000 cow years at risk.[10] Of these cases a third recovered, a fifth were slaughtered and the rest died or were killed. Extrapolation of these figures to the entire U.S. dairy herd of some 10 million cows results in an annual loss estimate in the range of $150 million. Atypical cases occurred following 1.9% of milk fever episodes in an Australian study.[15]

Originally, the downer cow condition was often thought of as a separate entity, but more recently it is commonly considered to be a complication of parturient hypocalcemia ("milk fever"). Minnesota research indicates that it would be more accurate to think of it as a complication of primary recumbencies due to a variety of causes (Fig. 1).[5 10] The most common cause of primary recumbency, however, is hypocalcemia, and therefore, this view is really a detailed refinement of the generally held notion.[4 11 14 19 25] While there appear to be a variety of conditions responsible for primary recumbency,[5 8 16 25] all recumbent animals are susceptible to pressure damage.[9] Pressure damage, then, is the common factor uniting all forms of primary recumbency and a common complication of all forms of recumbency.[8 9]

Prior to our pressure damage studies people who wrote about downer cows often stressed a variety of metabolic causes such as hypokalemia, hypomagnesemia, etc.[3 20 27] All these metabolic theories overlook the simple observation that many downers can stand on the forelimbs when lifted with hip clamps, but the hindlimbs often dangle in a useless fashion. Hip clamps would be useless if this was not true. Some downers will even sit like a dog using their forelimbs to prop themselves up (Fig. 2). Since it is hard to imagine a metabolic problem effecting only the hindlimbs, pressure damage to the hindlimbs is the most reasonable explanation for this observation. The forelimbs usually are not affected by pressure damage for two reasons. First, cows in sternal recumbency never place a forelimb under the body as they always do with the hindlimb. Secondly, the well-developed bovine sternum bears most of the weight during sternal recumbency so that very little weight is borne by the forelimbs. Occasionally, however, downer cows are seen with forelimb paralysis but this is due to compression of the brachial plexus against the ribs if a cow gets over in lateral recumbency or at least partially so (Fig. 3). Post mortem studies of clinical downers have confirmed the hindlimb predominence of the lesions.[19 25]

FIGURE 1. A schematic representation of the factors involved in downer cow pathogenesis.



Our experiments on cows and those of Lindsey on horses have demonstrated that pressures in excess of capillary closing pressure (30 mm Hg) frequently exist in the muscles of recumbent large animals.[21] The degree of the pressure damage is dependent on several factors which are in order of importance:

1. a. site of pressure damage
   b. duration of recumbency
   c. position of the animal
2. body weight
3. type of supporting surface (hard or soft)

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FIGURE 2. This downer cow could not stand on her hindlimbs but frequently assumed an unnatural position using the forelimbs. After several days of lifting in a livestock wheelchair, she made an uneventful recovery.

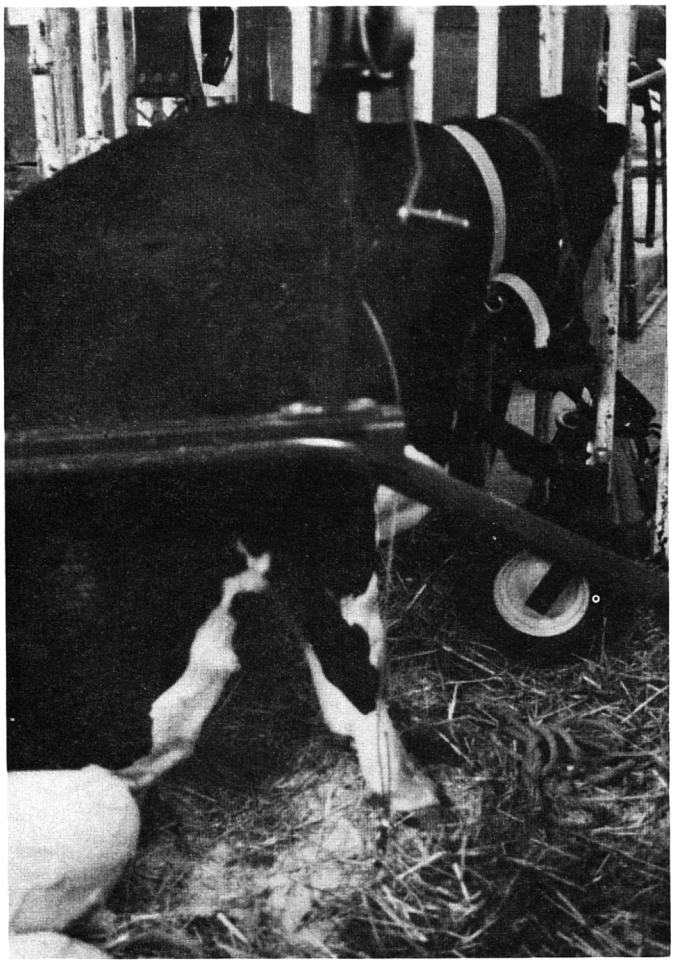
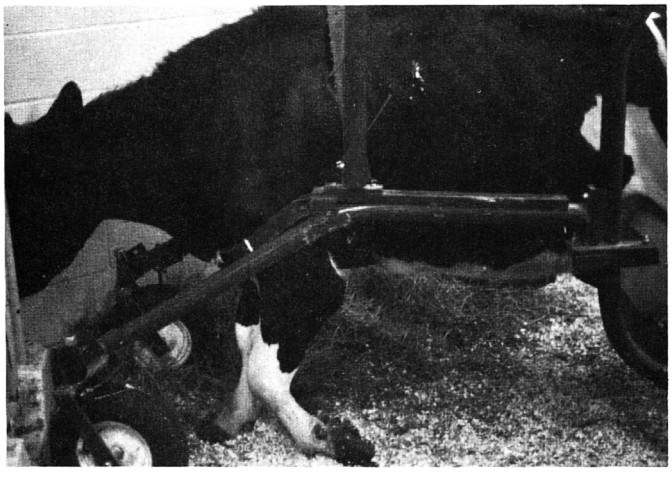


FIGURE 3. This cow developed a permanent forelimb paralysis following 1½ hours of lateral recumbency during teat surgery. After several weeks of non response to lifting therapy she was euthanized.



Pressure damage is greatest where soft tissue is compressed between the supporting surface and bone. There are several sites where nerves are vulnerable to compression damage due to their position close to bone (Fig. 4). Probably the most common site of pressure damage is on the lateral side of the stifle region where the common peroneal nerve runs over the head of the fibular bone (Fig. 4). Nerve damage here leads to peroneal nerve paralysis which results in knuckling over of the fetlock joint which is often seen in recovered downer cows (Fig. 5).[5] The knuckling over is due to loss of the digital extensor muscles. Another site of pressure damage is the upper end of the femur where the sciatic nerve is compressed against the caudal surface of the bone (Fig. 5). This site is of interest because it is close to the greater trochanter of the femur where muscle damage is intense in downer cows. This same area is one of the most severely affected sites of pressure damage in chronically bedridden human beings.[22] The problem here is so great that in some cases surgical removal of the greater trochanter is performed to prevent reoccurrence of the problem in such patients.[22]

FIGURE 4. Distribution of the bovine sciatic n. and its major branches. The arrows indicate where the nerve is most vulnerable to compression against bone.

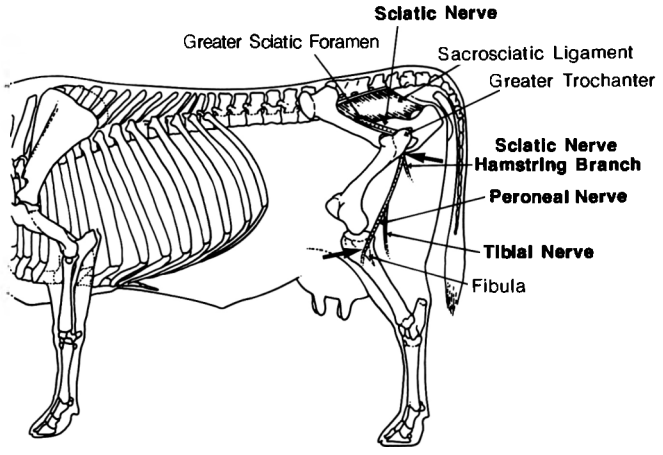


FIGURE 5. Buckling and knuckling of the fetlock joint in a recovered downer cow.

The 2 sites of nerve damage mentioned above are the sites where damage is often found on post mortem examination. In our pressure measuring experiments, we have recorded most commonly from the semitendinosus muscle in the caudal part of the thigh region. In this region we frequently find pressures in excess of 30 mm Hg and often over 100 mm Hg. Experiments thus far indicate that the tilt of the pelvis can be correlated with the pressure in the caudal thigh muscles. As the pelvis is tilted off horizontal, the pressure measurements decrease. Cows at rest will often roll briefly to the side and then back on to the sternum. Apparently this is an attempt to "get more comfortable" by subtle repositioning of the pelvis to relieve pressure on the down side hindleg. In order to eructate, they must lie on the sternum to prevent submersion of the cardia, but pain due to muscle pressure causes frequent slight modifications of the position. The position of greatest observed pressure is when the pelvis is in a position such that the tops of both hook bones (tuber coxae) are in a nearly horizontal plane. The head must be extended in front of the body to tilt the pelvis off horizontal, but when the neck is flexed to bring the head around into the flank as in the classic milk fever position, the pelvis is brought into a nearly horizontal position.

Clinical and experimental observations indicate that significant pressure damage can occur after 6 hours of recumbency. Experimental work has demonstrated reduction of nerve conduction velocity and muscle evoked potentials due to external pressure in a goat model.[24]

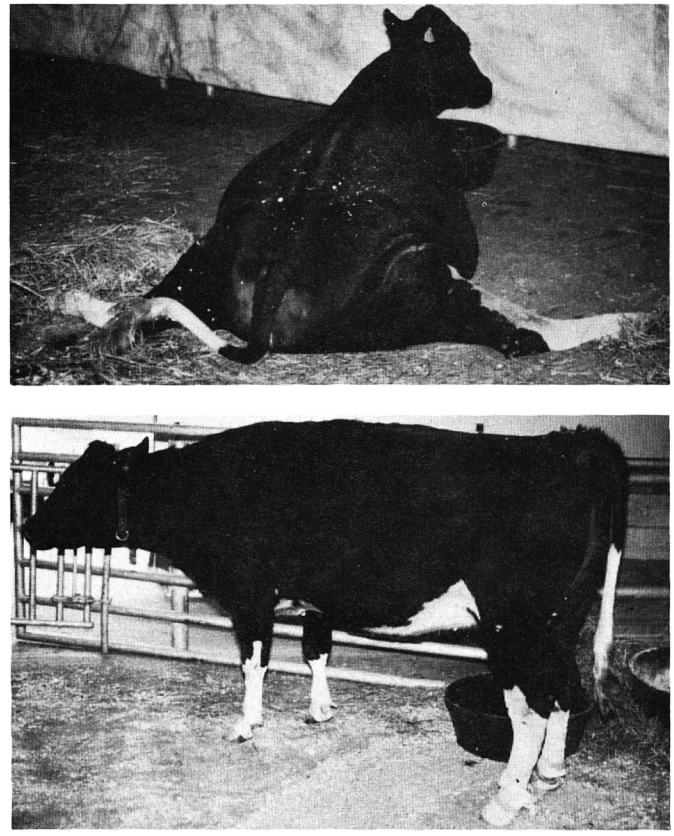
In our experiments we have used serum creatine kinase activity (CK, formerly CPK) as a measure of muscle damage. While this is a useful research technique, it is of limited value for clinical use. We have found that the serum CK activity of downer cows rises rapidly and peaks after 1½ to 2 days of recumbency and then falls rapidly even while th cow is still down. At 12 and 24 hours after going down, cows that have become downers and those that have already recovered have similar CK values.[9] This indicates that muscle dmage alone does not determine whether a cow becomes a downer or not. The combination of muscle damage and nerve damage, especially nerve damage, results in the downer condition. Since the CK assay is primarily a reflection of skeletal muscle damage and does not correlate with nerve damage, the assay is not useful for diagnosis or prognosis. There is a nervous tissue CK isoenzyme; but this assay, like the cardiac CK isoenzyme, is not available in most clinical diagnostic labs. If a small area of high pressure is centered in muscle, the resultant effect on the cow will be much less than when pressure damage is done to the sciatic nerve.

In our initial experiments with one hind leg under the body, we were struck by the difference between the compressed leg and the up leg even though the compressed leg was only under the body during the 6-hour period of the experiment in which the cow was maintained with halothane anesthesia.[9] After recovery from anesthesia, the leg was held to the side, was stiff, and then was swollen. On post mortem examination, the formerly compressed leg showed extensive ischemia, edema, discoloration, inflammatory tissue around the nerves and had a fetid odor. Contrastingly, the opposite leg, which was never compressed, appeared relatively normal in many cases. This led us to do additional experiments in which both hind legs were held along side the body. In these experiments about half of the cows became downers, as was the case in the one leg under the body experiments. This is because in the laterally held, extended hind leg, the sciatic nerve is compressed between the supporting surface and the upper end of the femur.

Body weight is a reason cattle are susceptible to the downer problem. The problem is very difficult to produce in goats subjected to the same experiment.[24] In 300-400 lb calves the recorded pressures are substantially lower than in cows. Not only is pressure higher in cows, they are more "clumsy." Af calf or goat with an injured hind limb does well as a "tripod," but a heavy cow has great difficulty standing on three legs.[24] It appears from our observations that the modern dairy cow has a body that is too large for her legs when the function of one leg is severely compromised.

On post mortem examination of downer cows it is often difficult to distinguish between lesions which were the initial cause of recumbency and those which are the result of being down. Muscle tearing and hip luxation are probably the

FIGURE 6. TOP: A downer cow in the spread eagle position. BOTTOM: The same cow standing after several days of lifting therapy.



result of struggling to get up, slipping,etc. The extreme abduction of the hind limbs (spread eagle position) does not always result in a permanent downer (Fig. 6). We have found that cows do much better in a sand-filled stall because it offers excellent footing and a softer surface. We have had several recoveries in this stall, but were surprised to find that when 6-hour anesthesia experiments were repeated, we could produce downers on the sand surface as we had on the hard rubber mat. The recovery rate, however, was better on the sand surface. Another benefit of the sand-filled stall is that cows on this surface stay cleaner than they do on straw, are easier to care for, and have little problem with decubital sores. Since downers usually have fairly dry stools, these can be shoveled up more easily than they can with straw. Because urine rapidly percolates through sand, urine scalding has not been a problem on this surface. The dairy person building a new barn would be wise to consider building several stalls which could be filled with 12" of clean sand. The stalls should have adequate drainage and gates to allow removal of soiled sand with a bobcat type loader. Every veterinary college should have the same.

Prevention and therapy of downer cows often involves the same measures. First of all, a good non-slip surface is very important. Concrete, especially wet slippery concrete, makes downers and then makes downers worse. Veterinarians and dairy people should work together to convince the authorities who set grade A standards that clean sand is better for the cow and more hygienic than the common alternative, the manure pack. It takes a considerable amount of manure to prevent cow feet from going through bedding and slipping on concrete. Certainly that much manure cannot be hygienic.

Any method that will reduce the incidence of milk fever will lower the incidence of downer cows. This can be achieved with proper feeding in the dry cow period and other methods that are beyond the scope of this report.[23] Close observation for signs of milk fever is important. Early diagnosis and treatment before the cow goes down will lower the incidence of the downer condition. The ultimate preventive device is a video monitor which allows the dairy person to check periparturient cows without leaving an easy chair.

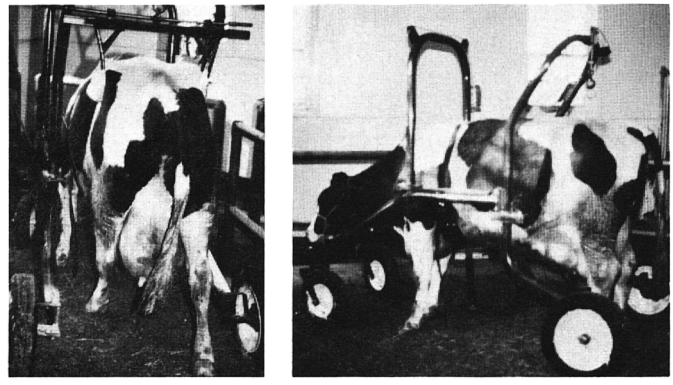
Calving in stanchions or tie stalls is particularly dangerous because the edge of the gutter can cut into the hamstring muscle and put pressure on the sciatic nerve.[16] Cows in unsafe places should be moved as soon as possible to a sand or dirt surface. The cow should be slid on to a sheet of plywood with traction applied to the plywood rather than the cow. Although cows are tough, adding insult to injury will only worsen the problem.

Lifting devices are useful for diagnosis and sometimes for therapy. The legs of a recumbent cow can be examined more thoroughly after it is lifted. Cow lifters, such as the Paralift or Cow Bouy, which use a winch to elevate the hip clamp, allow evaluation of hindlimb function by gradually lowering the rear quarters. If any slack is noted in the cable, then some weight is being borne by the hindlimbs. These are the cases where lifting devices are useful for therapy. There are some cows that are not able to stand on their own, but once lifted to a standing position can remain up without additional support. These are the cows for which lifting is very helpful. Usually these cases will recover in a few days. If a cow cannot support herself completely when lifted but occasional slack of the winch cable is noted, there may be hope for the cow although several weeks will be required for recovery. If the hind limbs dangle and show no signs of support after lifting, the prognosis is guarded and hip clamps should be avoided. Additional information can be gained by sensation testing and noting the quality of the withdrawal reflex. A well-charged electric prod works better here than pin pricking. An electric prod applied to the forelimb fetlocks will often cause an uncooperative downer to stand on the forelimbs after lifting the rear quarters.

Hip clamps have a bad reputation due to misuse. When combined with a cart, winch, and a sternal band (livestock wheelchair), they are much more useful and less dangerous. When the hip clamp is fixed to the ceiling or a tractor loader, the cow will swing like a pendulum if she attempts to move. The cart, however, will move with her and the sternal band will provide additional support which lessens hip clamp damage. The mild pain of the hip clamp may cause the cow to try to extend the hind limbs to take weight off the hip clamp and thus relieve that pain. Some cows can stand on their own 5 or 10 minutes after being lifted in a livestock wheelchair (Fig. 7). These borderline downers apparently are too weak to rise on their own but are able to support their own weight once helped to a standing position. Borderline downers are the cases where livestock wheelchairs are most useful for therapy, but the devices are useful for diagnosis and prognosis of all cases. Rapid diagnosis of a borderline downer is achieved by lifting, but some of these cows would probably recover on their own if given enough time and a dirt or sand surface.

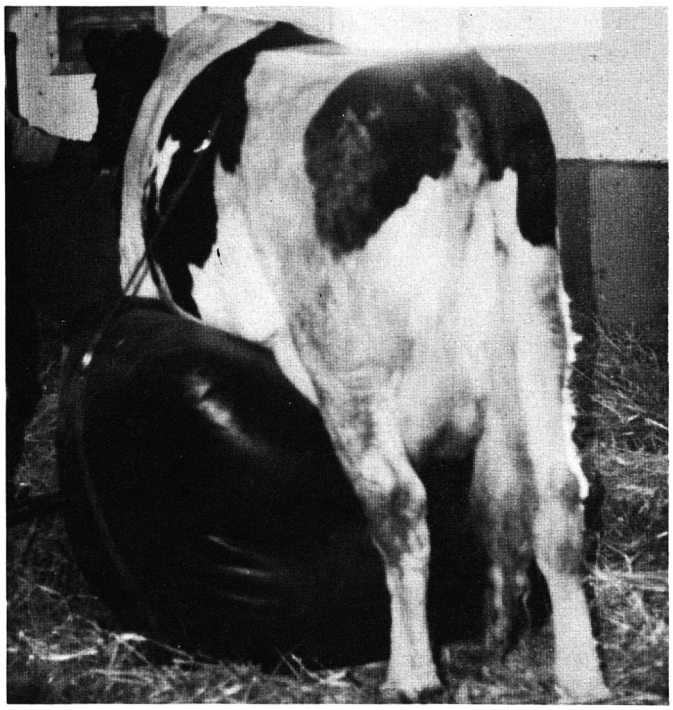
Cows which show some tendency to support their weight briefly after lifting should be given a guarded prognosis. In

FIGURE 7. A border line downer cow in the cow lift for the first time (left) and 5 minutes later (right). This cow made an uneventful recovery after several days of lifting therapy.



these cases the lifter is useful for milking the cow and cleansing the skin. If the hip clamps are well padded, twice daily lifting for 10-15 minutes will be well tolerated for several weeks. Foam ¾" pipe insulation which is available in hardware stores works well for padding for most hip clamps. It can be secured with bandage tape and should be replaced when soiled. Cows should never be left in a livestock wheelchair unattended. The wheelchair is also useful for moving a cow off concrete onto a better surface. In short, these devices can be a practice-building tool, but they can also be dangerous to both cattle and the operator. If brake winches are not installed on the livestock wheelchair, the owner of the device could be vulnerable to suit along with the manufacturer.

FIGURE 8. Lifting a downer cow with an air bag. This cow stood for a minute after the bag was deflated. It went down as soon as it moved to the right but recovered after several days of lifting.



Lifting with air bags is popular in England and with people who are concerned about the humane aspects or are worried about damage due to use (misuse) of hip clamps. The problem with lifting from below is that the belly is soft. Before the body is lifted, the abdominal contents are forced against the diaphragm making respiration difficult, and hence, the cow quits trying to stand on her own. We have had 3 cases where the air bag worked well, but all of these would have done well if lifted with other methods (Fig. 8).

In conclusion, there are no "magic bullets" for downer cows and no completely reliable diagnostic/prognostic tests. Prevention is preferable to therapy, and good management will aid the healing process. Pressure damage must be reduced concurrent with treatment of the metabolic or toxic problem.

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