Calving Difficulty in Beef Cattle: A Review
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Calving Difficulty in Beef Cattle

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Calving difficulty (dystocia) can increase calf losses, cow mortality, and veterinary and labor costs, as well as delay return to estrus and decrease conception rates. In two studies at the U.S. Meat Animal Research Center (MARC), Clay Center, Nebraska, calf losses within 24 hours of birth averaged 4 percent for those born with little or no assistance, compared to 16 percent for those requiring assistance. Calf mortality increased by a 0.35 percent per pound increase in birth weight. In a Hereford herd at the U.S. Livestock and Range Research Station, Miles City, Montana, 57 percent of all calf losses were reported to be due to dystocia.

Researchers at MARC noted that the number of cows detected in estrus during a 45-day A.I. period was 14 percent lower in those requiring assistance than in those calving with no difficulty. Conception to A.I. was 6 percent lower in cows experiencing dystocia than in those with no dystocia. Pregnancy rate after the entire breeding season (70 days) was 16 percent lower in cows that had been assisted (85 percent vs. 69 percent). At Miles City, pregnancy rate among cows that had caesarean deliveries was 26.6 percent lower (52.4 percent vs. 79.0 percent) than the herd average.

Factors Affecting Dystocia

The numerous factors that are believed to influence calving difficulty are listed below. As will be noted later, several of these factors are interrelated.

- Age of dam
- Calf's birth weight
- Sex of calf
- Pelvic area
- Gestation length
- Cow size
- Shape of calf
- Breed of sire
- Breed of dam
- Uterine environment
- Hormonal control
- Geographic region
- Season of year
- Environmental temperature
- Nutrition of dam
- Condition of dam
- Implants and feed additives
- Feeding time
- Exercise
- Other unknown factors

This bulletin covers these factors and finishes with a discussion of calving time management and genetic management.

Age of Dam

Table 1 is a summary of calving data from MARC and Colorado State University (CSU), relating age of dam to calving difficulty. These data illustrate that age of dam has a profound effect on the incidence of dystocia. First-calf, two-year-old heifers represent the greatest source of trouble to the beef herd owner. Difficulty in two-year-olds is three to four times as high as in three-year-olds, and three-year-olds have about twice as much difficulty as four-year-olds. By the time a cow reaches four to five years of age, dystocia problems are minimal. Calving difficulty in MARC Hereford and Angus cows was higher than in CSU Hereford cows, presumably because the former tended to be mated to larger continental sires, whereas the latter were mated only to Hereford sires.

Table 1. Effect of dam's age on calving difficulty

Dam's age(years)	Research station MARC	CSU
	% calving difficulty	
2	54	30
3	16	11
4	7	7
5 (and Over)	5	3

Calf's Birth Weight and Sex

Table 2 is taken from a Miles City study correlating calving difficulty with several traits in two-year-old Hereford and Angus heifers. A perfect correlation would be 1.0; anything over 0.40 was highly significant; 0.18 to 0.40, significant; less than 0.18, nonsignificant. Birth weight of the calf was the trait most highly correlated with calving difficulty, followed by sex of calf. Pelvic area, gestation length, and cow weight had considerably less influence. Much of the influence of sex of calf is believed to be indirect, through its effect on increased calf size. However, after correcting for birth weight, differences in dystocia between sexes still remain, suggesting that factors other than fetal size may be involved.

As birth weight increases, percent of assisted births increases 0.7 percent to 2.0 percent per pound of birth weight. Compared to heifer calves, bull calves have slightly longer gestation length, weigh 5 to 12 pounds more at birth, and exhibit a 10 to 40 percent higher assistance rate. Several researchers have reported that calves requiring assistance weigh five to seven pounds more than those born without assistance. Research has also shown that the impact of birth weight on dystocia is much greater in two-year-old cows, and that as cows become older, birth weight assumes less significance.

Pelvic Area

It is generally agreed that a major cause of dystocia is the disproportion between the size of the fetus and the pelvic opening of the dam, especially in first-calf heifers. This disproportion is illustrated in Table 3, which is a summary of data from CSU. As birth weight increased and pelvic area declined, calving difficulty increased. Relative to the amount of variability in the two traits, changes in birth weight were considerably greater than changes in pelvic area. Unfortunately, phenotypic correlations between pelvic area and calving difficulty are not high, averaging only -.20 (Table 2).

Heritability estimates for pelvic area are moderate to high, averaging about .50. This means that selection for larger pelvic size can be quite effective. However, several studies have demonstrated a positive relationship between pelvic area and body size (weight and frame) from birth to 18 months. Consequently, selection for increased pelvic area without some constraint on body size could possibly result in a parallel increase in birth weight and mature size and little change in calving ease. Therefore, it has been recommended by several researchers that selection for increased pelvic area be conducted within a size category.

Many authorities agree that pelvic size should be viewed as a threshold trait and that heifers below a certain minimum pelvic area should be culled. Prebreeding minimum culling levels for pelvic area may range from 140 to 180 square centimeters depending upon the breed, herd, environment and

Table 2. Effect of various traits on dystocia in Hereford and Angus heifers

Trait	Breed of cow Hereford	Angus
	Correlation with dystocia	
Calf's birth weight	.54	.48
Calf's sex	-.47	-.26
Pelvic area, precalving	-.18	-.22
Gestation length	.25	.10
Cow wt., precalving	-.01	-.20

other factors. Based on Miles City data, pelvic measurements have limited usefulness in predicting dystocia on an individual basis, but can be significant herd-wide. Their research shows that a 10 square centimeter increase in pelvic area would be accompanied by a two pound increase in calf birth weight and a 0.02 decrease in calving difficulty score.Many purebred breeders now measure pelvic areas on their yearling bulls and publish the data in their sale catalogs. Because the genetic correlation between male and female pelvic area is high (.60), selection for increased pelvic size in bulls should result in increased pelvic size in heifer progeny. However, as noted above, selection for increased pelvic size should not be conducted without some constraint on birth weight. If no attempt is made to control birth weight, selection for increased pelvic size by itself may not be very effective. Ideally, pelvic areas listed in sale catalogs should be adjusted to a standard age such as 365 days. The Beef Improvement Federation (BIF) suggests the following age adjustments be used: .25 and .27 square centimeters per day of age for yearling bulls and heifers, respectively.

Table 3. Effect of birth weight and pelvic area on calving difficulty in first-calf heifers

Calving difficulty score	Yearling pelvic area (sq cm)	Calf birth weight (lb)
1 (no asistance)	151	72
2 (minor assistance)	145	77
3 (major assistance)	141	82
4 (caesarian)	131	94

Gestation Length

As shown in Table 2, gestation length is not highly correlated with dystocia. Using Simmental field data, Cornell University researchers reported similar results. They found the correlation between birth weight and calving difficulty to be somewhat higher than the correlation between gestation length and calving difficulty (.40 vs. .26). They concluded that sire differences in gestation length are not particularly useful predictors of differences in calving ease and that birth weight is a better, and more frequently recorded, predictor of calving ease. Nevertheless, using short-gestation sires has two important advantages: (1) calves are older and heavier at weaning time; and (2) because calves are born earlier, the cows have more time to recover and rebreed on schedule.

Cow Size

As indicated in Table 2, smaller heifers tend to have a higher incidence of dystocia than larger heifers but the correlations are low (-.01 and -.20). In Alberta research, it was reported that the ratio of calf birth weight to dam weight was the most important factor affecting dystocia, accounting for 28 percent of the total variation in calving difficulty. Calf birth weight by itself accounted for 18 percent of the total variation, and the dam's pelvic area accounted for less than 1 percent of the total variation. If one reviews all of the research that has been conducted on calving difficulty, no more than 50 percent of the total variation in dystocia can be explained by factors that can be defined or measured. In many studies, only 20 percent to 30 percent of the variation can be explained by quantifiable traits.

Shape of Calf

Many cattle producers believe that differences in a newborn calf's shape can have an important effect on ease of delivery. For example, a slender, lighter-muscled, finer-boned calf theoretically should be born more easily than a thicker, heavier-muscled, coarser-boned calf of the same weight. However, researchers at MARC were unable to find any calf shape measurements which were significantly correlated with calving ease, even though they believe that such relationships likely exist. Data from Germany showed a relatively high correlation (.62) between chest girth at 330 days of age in Simmental sires and the calving difficulty of their progeny. In France, it was reported that the calf's body length and rump width were significantly correlated with calving difficulty in two-year-old cows and that selection of French beef breeds based on muscle development and growth rate early in life led to an increase in birth weight and calving difficulty. In a Virginia study, researchers concluded that selection for calf shape, independent of birth weight, would not be expected to reduce dystocia. In summary, calf shape probably plays a role in dystocia but it is extremely difficult to quantify.

Breed of Sire

Research at MARC and elsewhere has demonstrated that significant differences exist between breeds of sires in calving difficulty and birth weight. In Cycles I, II and III (1970-76) at MARC, average assistance rates and birth weights of half-blood calves sired by 16 diverse breeds ranged from 2.9 to 20.4 percent and from 68.6 to 90.6 pounds, respectively. In Cycle IV (1986-89), the ranges were 0.3 to 9.2 percent and 71.3 to 90.2 pounds. In general, birth weights and assistance rates increased as mature size and growth rate increased.

Breed of Dam

Breed of dam effects on dystocia and birth weight do not follow a consistent pattern, except for Zebu-influenced females. Data from many sources clearly demonstrate that as the percentage of Zebu breeding increases in the dam, birth weight and dystocia decline. In Cycles I, II and III at MARC, Brahman- and Sahiwal-sired F_1 dams exhibited assistance rates of only 1 and 2 percent respectively, compared to a range of 7 to 17 percent for 14 European breedtypes.

Uterine Environment

Researchers at MARC reported that fetal growth during the last 20 percent of gestation is dramatically lower in Brahman than in Charolais cows, which helps explain the lower birth weights of calves from Brahman-influenced dams, as noted above. They provided evidence which suggested that this difference is due to differences in uterine blood flow and function of the utero-placental tissues. Research at Miles City has likewise shown that diverse breeds of dams differ greatly in the growth rate of the fetuses they are carrying.

Hormonal Control

Several hormones are associated with parturition (e.g., ACTH, cortisol, estrogen, prostaglandin, progesterone, oxytocin and relaxin). Increased blood levels of relaxin prior to parturition have been shown to enhance cervical and pelvic dilatation, resulting in normal delivery of the fetus. Unlike some species, circulating blood concentration of relaxin in cows remains consistently low during the last days of pregnancy. Iowa research has shown that injecting first-calf heifers with relaxin within the last five to six days before calving significantly reduces the incidence of dystocia. Cows can be induced to calve within 48 to 60 hours by injecting them with a corticosteroid or a prostaglandin within 10 days of parturition. However, such treatments commonly result in difficult calvings and retained placentas. When the Iowa researchers combined relaxin with either dexamethasone (a corticosteroid) or cloprostenol (a prostaglandin), these problems were reduced significantly. Whether hormonal control of parturition can become a practical management strategy remains to be determined.

Geographic Region

Hereford cows of comparable genetic makeup were moved from Miles City, Montana, to Brooksville, Florida, and vice versa. Ten years after this switch was made, birth weights in the Montana herd that had been moved to Florida had declined from 81 to 64 pounds. Conversely, birth weights in the Florida herd that had been moved to Montana had increased from 66 to 77 pounds. Other studies have yielded similar results, indicating that calves of comparable genotype will be born lighter in the south than in the north.

Season of Year

Research has shown that calves born in the fall of the year are generally lighter in weight and experience less dystocia than those born in the spring.

Environmental Temperature

Prolonged exposure to high environmental temperatures will result in reduced birth weights, which can in turn lower the incidence of dystocia. There is less information on cold stress. However, the available data have shown that low environmental temperatures are related to heavier birth weights and increased calving difficulty. It is likely that differences observed between geographic regions and seasons of the year, as discussed above, are related to differences in environmental temperature.

Dietary Energy

Many cattle producers believe reducing dietary energy during late pregnancy will decrease fetal size and improve calving ease, whereas increasing energy will increase fetal size and lead to a higher incidence of dystocia. Research has shown that lowering the energy allowance will decrease birth weight but will not significantly reduce dystocia. At MARC, Hereford and Angus two-year-old heifers were fed three levels of energy (10.8, 13.7 or 17.0 lb TDN/head/day) for 90 days prior to calving. Increasing the level of dietary energy resulted in increased birth weight but not increased dystocia; in fact, the incidence of calving difficulty was lower in the medium- and high-energy groups than in the low-energy group.

Inadequate nutrition of the young developing heifer can affect her subsequent calving performance. Miles City research showed that restricting the energy of weaned heifer calves during their first winter can have a carry-over effect, resulting in decreased precalving pelvic area and increased dystocia (46 percent vs. 36 percent) compared to adequately fed heifers. From weaning to first breeding as yearlings, heifers should be fed to weigh at least 65 percent of their potential mature cow weight. This translates to a range in average daily gain of approximately 1.25 to 1.75 pounds for 200 days. Depending upon initial weight, frame size, body condition and environment, this means that daily TDN requirement will range from 8 to 13 pounds per head.

When they calve as two-year-olds, heifers should weigh 85 percent of their mature cow weight. This translates to an average daily gain of about 1 pound per day from breeding to calving. Adequate pasture conditions will support this level of performance. During the winter prior to calving, pregnant heifers require from 9 to 13 pounds of TDN per day. The mature pregnant cow requires from 7.5 to 13 pounds of TDN.

Dietary Protein

There is some concern in the cow-calf industry that high levels of protein during the last trimester of pregnancy may lead to a significant increase in birth weight and dystocia. At Miles City, crossbred two-year-old pregnant heifers were fed diets containing either 86 percent (low) or 145 percent (high) of the NRC crude protein requirement for 82 days prior to calving. Heifers fed the low-protein diet had significantly lighter calves at birth and less calving difficulty. Heifers on the high-protein diet gained more weight, had higher condition scores at calving, maintained more body weight throughout the study, and weaned significantly heavier calves. In a repeat study at Miles City, there were no differences in calf birth weight or calving difficulty. Research at other institutions has shown no consistent effect of protein level on dystocia. It would appear that precalving dietary protein level should be near the NRC requirement. If it is extremely low, weight and condition of the cows and weight, vigor and postnatal growth rate of the calves may be reduced. If it is unduly high, it represents an economic waste. During the last trimester of pregnancy, crude protein requirements range from 8.2 to 9.8 percent for heifers and 7.6 to 8.2 percent for mature cows.

Body Condition

Prior to the last trimester of gestation, females should be evaluated for body condition. Those in thin condition (body condition score 4 or less on a 1 to 9 scale) should be fed separately from those in moderate or higher condition so their dietary energy level may be increased. By calving time, the goal would be to have mature cows in moderate condition (score of 5) and first-calf heifers in high moderate condition (score of 6). Overfeeding females to the point of obesity has been shown to increase the incidence of dystocia. Texas researchers reported that as fatness score increased above a moderate level in first-calf Santa Gertrudis heifers, calving difficulty increased. They concluded that efforts should be made prior to calving to prevent overconditioning of females in an effort to reduce dystocia.

Implants and Feed Additives

Numerous studies have shown that implanting heifer calves with zeranol (Ralgro®) increases pelvic area at breeding time. However, in most instances, this increase did not persist up to calving time and there was little effect on calving difficulty. Similar results have been reported when Synovex-C® implants were used on suckling heifer calves. Some producers believe that feeding an ionophore such as monensin (Rumensin®) or lasalocid (Bovatec®) increases calving problems. However, research has shown these compounds have no effect on gestation length, calf birth weight, pelvic area, or dystocia.

Feeding Time

The time of day the cow herd is fed during calving season has been shown to influence when calves are born. The data indicate that cows fed at night are more apt to calve during daylight hours when they can be observed closely. Gus Konefal, a Hereford breeder in Manitoba, was the first to recommend this feeding strategy. Consequently, it has been called the "Konefal Method" of daytime calving. This system involves feeding twice daily, once at 11:00 a.m. to 12 noon and again at 9:30 p.m. to 10:00 p.m. This regimen starts about one month before the first calf is born and continues throughout the calving season By following this feeding program, Konefal reported that 80 percent of his cows calved between 7:00 a.m. and 7:00 p.m. Similar results were obtained in a study at Iowa State University. These two studies prompted Miles City researchers to conduct a three-year study on feeding time. Their results were not as dramatic as those of the earlier studies. Nevertheless, the percentage of cows calving between 10:00 p.m. and 6:00 a.m. was consistently 10 to 20 percent lower for the late-fed than for the early-fed cows. Similar research conducted at the Brandon Research Station showed a 13.5 percent reduction in cows calving between midnight and 7:00 a.m.

Exercise

Forced exercise for several weeks prior to calving has been shown to improve the calving ease of closely confined dairy heifers. However, Miles City researchers could find no difference in calving ease between heifers maintained in a typical feedlot and those forced to walk two miles a day. It was concluded that unless beef heifers are under extremely close confinement, exercise is of no benefit in reducing dystocia.

Table 4. Heritabilities of growth traits and their genetic correlations with birth weight

Trait	Heritability	Genetic Correlation with Birth Weight
Birth weight	.41	—
Weaning weight	.32	.36
Yearling weight	.43	.29
18-month weight	.61	.69

Calving Time Management

In addition to knowing how to give assistance, it is also important to know when to help. For years, the general recommendation was to intervene if the cow was in intense labor for two to three hours without making progress. Research at Miles City suggests that it may be beneficial to give assistance earlier. They reported that intervening as soon as the cervix was fully dilated and the membranes and the calf's feet extended from the vulva (beginning of second stage of labor) resulted in significant advantages over a group of females that received no assistance unless it was needed to save the calf. These advantages were: higher percent in heat at beginning of breeding season (91 percent vs. 81 percent); higher first service conception rate (75 percent vs. 60 percent); and higher pregnancy rate in October (90 percent vs. 76 percent). These advantages were observed in mature cows as well as in first-calf heifers. It was reported that duration of the second stage of labor averaged 54 minutes for heifers and 23 minutes for cows. Out of this research, the following time limit was set at the Miles City station: if definite progress has not been made after one hour of intense labor, the calf is pulled. They caution, however, that the cervix should be fully dilated and the calf's feet visible. Also, the position of the fetus must be normal; for example, if either of the legs or head are back, they must be corrected before assistance is given.

Genetic Management

From a genetic standpoint, there are several traits which may be considered in a selection program to keep dystocia under control. They are: (1) Individual birth weight; (2) EPD (expected progeny difference) for birth weight; (3) The sire's EPD for direct (his own) calving ease on first-calf heifers; (4) The sire's EPD for maternal (his daughters) calving ease on first calves; (5) The sire's pelvic area; (6) The pelvic area of potential replacement heifers.

Birth Weight and EPDs for Birth Weight

Although individual birth weights can be used as a guide in selecting young unproven bulls, EPDs are better predictors because they combine data from several sources — the individual, his ancestors and his half-sibs. As a bull becomes older and sires a significant number of progeny, the accuracy of his EPDs improves markedly. By then, his individual birth weight is of little significance. A number of studies have shown strong correlations between EPDs of sires and actual birth weights of their progeny, especially among sires with high accuracy (over .80).

In order to minimize dystocia in first-calf heifers, ideally they should be mated to bulls with breed average or lower birth weight EPDs. For maximum precision, a young unproven bull's EPD should be compared against the breed average for bulls in his own birth year group. Breed average information is contained in many of the sire summaries published by breed associations.

As noted before and shown in Table 4 (CSU data), birth weight is a moderately heritable trait and is positively genetically correlated with other growth traits. Therefore, many bulls having average to below average birth weight EPDs will be average or lower for other growth traits. However, there are exceptions. A search of sire summary lists can be used to identify bulls that have low birth EPDs and high weaning and yearling EPDs.

A calf's birth weight is influenced by both the sire's and the dam's genotype for birth weight. Therefore, selecting heifers from sires with low birth weight EPDs can stack the herd's pedigrees in favor of calving ease.

EPDs for Direct Calving Ease

Except for Simmentals, this EPD is reported as a ratio; sires with higher ratios will calve easier when mated to first-calf heifers. The Simmental Association provides direct calving ease EPDs for both heifers and cows. Simmental EPDs are expressed in percent unassisted births, with positive numbers indicating greater calving ease. In general, EPDs for direct calving ease are closely related to EPDs for birth weight. All breed associations publish EPDs for birth weight, but only a few associations report calving ease EPDs.

Maternal Calving Ease

This trait is reported and interpreted in a manner similar to direct calving ease. This EPD predicts how easily a sire's daughters will calve, not how easily the sire himself will calve.

Heritability estimates of calving ease have been lower than those reported for birth weight. This suggests that genetic progress made by selecting directly on calving ease EPDs would be slower. An exception would be the Simmental breed in which calving ease EPDs have been shown to be a more accurate indicator of dystocia than birth weight EPDs. This is because Simmental calving ease EPDs incorporate birth weight as well as a score for calving ease. For long-term improvement in the herd, using sires with high maternal calving ease EPDs and retaining their daughters should be beneficial.

Pelvic Area

Please refer to pages 2 and 3 for a complete discussion of selecting for pelvic area.

Selecting Natural Service Bulls

The producer who is not in a position to artificially inseminate first-calf heifers does not normally have the option of using highly proven sires with high accuracy EPDs for birth weight and/or calving ease. An alternative is to purchase an older bull, known for his calving ease, from another producer in the area. Transmission of disease is a potential risk when this is done. A more realistic option is to purchase an unproven bull that has a low birth weight EPD, a large pelvic area and a low individual birth weight (adjusted for age of dam). If birth weight EPDs are not available, try to look for sons of highly proven calving ease sires. Even better, look for young bulls whose sire and maternal grandsire are both highly proven calving ease sires. If no information is available except for an individual birth weight, consider the age of the dam when the bull was dropped because younger cows give birth to lighter calves. Ideally, birth weights should be adjusted to a 5- to 10-year-old dam equivalent by adding the following adjustments: 2-year-olds, 8 pounds; 3-year-olds, 5 pounds; 4-year-olds, 2 pounds; 11-year-olds and over, 3 pounds. These are standard adjustments published by the Beef Improvement Federation; some breeds have their own adjustments. However, relying solely on individual birth weight is risky business. A low birth weight bull whose sire was unknowingly a hard-calving bull is not likely to be a good candidate for use on virgin heifers.

Summary

In summary, research has shown the following strategies to alleviate calving problems:

1. Develop heifers properly so they achieve at least 65 percent of their mature weight by breeding time and 85 percent by the time they calve as two-year-olds.

2. Breed virgin heifers one heat period before the mature cow herd and give them extra attention at calving time.

3. Know the pregnant female's nutrient requirements. Neither underfeed nor overfeed her. Body condition scores at calving time should fall within a range of 5 to 6 on a 9-point scale.

4. Using the Konefal Method may cause more females to calve in the daytime when they can be observed closely.

5. Know when and how to give assistance and when to consult a veterinarian.

6. Measure pelvic areas of potential replacement heifers and cull the lower end.

7. Mate virgin heifers to low-risk bulls:

a. Proven AI sires with high accuracy EPDs for birth weight and/or calving ease.

b. Unproven bulls with low birth weight EPDs, large pelvic areas and low individual birth weights.

8. Retain daughters of sires that combine low birth weight EPDs and high maternal calving ease EPDs.

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