

Cattle Industry Has Tools to Manage Genetic Abnormalities

by Kent Andersen, Ph.D., executive vice president,
and Erin Garrick, member services specialist

Historically, in addition to recording pedigree and performance information and providing genetic predictions, the performance programs at cattle breed associations have monitored and managed genetic abnormalities. While there has been relatively little news on that subject for the last decade, several defects have recently emerged. Some are in popular lines of cattle, and they often warrant the attention of breeders and commercial producers.

By our account, there currently are about 10 different abnormalities in various stages of “active” management by different beef breeds. (See the table.) You might think of those stages of management as initial investigation, DNA-test development, implementation of genotyping (testing) and associated policy, and (ultimately) effective eradication through continued testing and selection.

Fortunately, most of the defects listed are rare, effectively have been eliminated, are nonlethal, or are under aggressive management via DNA-based diagnostic tests and pedigree analysis.

We know other abnormalities exist, but the industry has isolated them, or they are of such extremely low frequency that they are not threatening. As the table shows, breed associations have worked behind the scenes over the years to monitor abnormalities and address those that represent even relatively minor concerns.

Inheritance

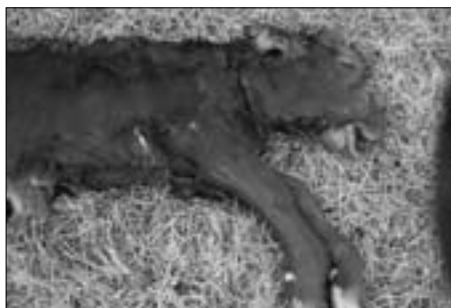
With a couple of presumed exceptions, the defects listed in the table are of



Arthrogryposis Multiplex (AM)—“Curly Calf”
Photo by Dr. David Steffen, University of Nebraska



Hydrocephalus—small body, large head, short face, cleft palate
Photo by Dr. David Steffen, University of Nebraska



Osteopetrosis—Short lower jaw
Photo by Dr. David Steffen, University of Nebraska



Fawn Calf Syndrome



Hypotrichosis—hairless calf
Photo by Dr. Jonathan Beaver, University of Illinois



Protoporphyrria
Photo by Dr. Kent Andersen, North American Limousin Foundation

genetic origin and the result of a simple recessive mode of inheritance. (See the figure.) By that definition, affected or diseased offspring possess two copies

of the defective gene. That means both parents of affected progeny are carriers.

With that type of inheritance, without results from DNA or progeny tests,

animals that are free of the defective gene (normal) generally are indistinguishable from those that are carriers. The figure illustrates the proportion of progeny that are free, carrier and diseased from use of a carrier sire bred to normal (free) and carrier dams.

With a simple recessive mode of inheritance, once significant numbers of influential animals in a population have been genotyped (DNA-tested), we can use pedigree relationships to infer genotypes for many untested animals. That can give them a virtual “clean bill of health,” while others can be identified as suspects and a high priority for testing.

Remember, inferred genotypes for defects are subject to error if pedigrees are incorrect. Conversely, DNA-based genotypes for genetic abnormalities occasionally serve to help us discover pedigree errors for recorded animals.

Tracking

Seedstock and commercial producers alike should be on the lookout for abnormal calves before and during calving season. If you observe unusual calves or abortions, contact the respective breed association. Generally, you should capture DNA (via blood card, ear punches or roots of tail-switch hair) from

the affected animal and its parents (for parentage verification and genotyping for the defect). The association also might advise diagnosis by a veterinarian, a digital picture and (occasionally) preservation of the affected animal.

Given the prevalence of some recently documented genetic abnormalities, seedstock and commercial producers should examine the pedigrees of potential at-risk animals—with special attention given to their bull batteries.

That assessment is much easier if all bulls have been registered and transferred so their identities and recorded pedigree information are available. The various associations provide genetic defect information for specific animals in their breeds on their Web sites. Contact the breed association if you need help obtaining information about a given animal’s genotype for

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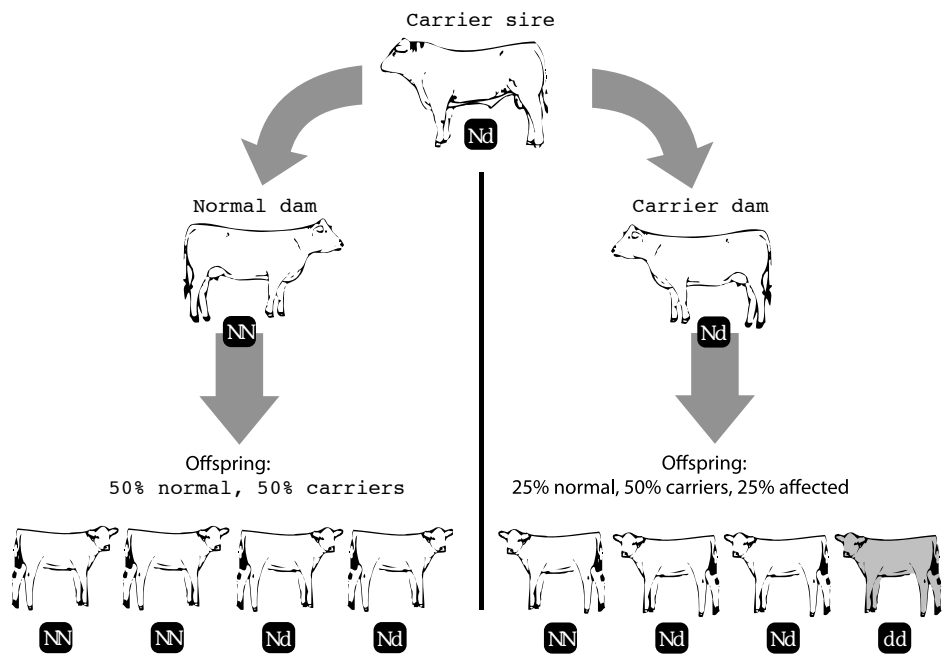


Table. Genetic Abnormalities Under Management by Beef Breed Associations

Genetic Abnormality	Primary Breed(s) of Incidence	Lethal or Nonlethal	Mode of Inheritance	DNA Test Available?	Management Stage
Arthrogryposis multiplex (AM) or “Curly Calf Syndrome	Angus & derivatives	Lethal	Simple recessive	Yes	DNA testing underway
Beta (β)-Mannosidosis	Salers	Lethal	Simple recessive	Yes	Effectively eradicated
Fawn Calf Syndrome (FCS)	Angus	Nonlethal	Presumably simple recessive	No	Under investigation
Hydrocephalus	Angus	Lethal	Presumably simple recessive	No	Under investigation
Hypotrichosis (hairless calf)	Hereford	Nonlethal	Simple recessive	No	Under investigation
Idiopathic epilepsy	Hereford	Nonlethal	Simple recessive	Yes	DNA testing underway
Osteopetrosis	Angus & Red Angus	Lethal	Simple recessive	No	Under investigation
Protoporphyrria	Limousin	Nonlethal	Simple recessive	Yes	Effectively eradicated
Pulmonary hypoplasia & anasarca (PHA)	Maine-Anjou & Shorthorn	Lethal	Simple recessive	Yes	DNA testing underway
Tibial hemimelia (TH)	Shorthorn & Maine-Anjou	Lethal	Simple recessive	Yes	DNA testing underway

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an abnormality documented in the respective population.

Avoidance

For commercial producers, the trick to avoiding calves with lethal or performance-threatening abnormalities is never to mate a carrier bull to a carrier female. The first and easiest line of defense is to use only bulls that are free of the relevant defect in a given population.

Animals can be determined as free or low likelihood of being carriers either by virtue of a “clean” pedigree—no known carriers among close ancestors—or free as determined by DNA test or absence of the defect in that breed. Using only defect-free bulls is especially important for commercial producers who might have carrier daughters they are breeding back to bulls of the same breed.

Seedstock producers should test all bulls and females that have an appreciable likelihood of possessing a documented defect (that is, from a carrier ancestor) before sale. Hybrid seedstock producers have the added responsibility of knowing the pedigrees and managing abnormalities for all of the breeds used in producing their hybrids. It follows that breed associations with upgrading programs must execute policies and provide information that prevent abnormalities from migrating into their purebred populations.

Mutations that cause abnormalities always will be a reality of the livestock business. Fortunately, with advances in genomics technology and thoughtful management by associations and breeders, we can mitigate the adverse affects substantially. **LW**