Biography:
Dr. Colin Palmer is an Associate Professor of Theriogenology (Animal Reproduction) at the Western College of Veterinary Medicine. Originally from Nova Scotia, Dr. Palmer worked in mixed practices in Ontario and British Columbia and has owned/operated a practice in Saskatchewan. Dr. Palmer along with his wife Kim and children Lauren, Emily and Carter run a herd of purebred Red Angus cattle under the KC Cattle Co. name.

A Breeder's... Veterinary Perspective

Causes of Abnormal Sperm Morphology

This article is really a continuation of two previous articles, Breeding Bull Management Summer 2009 and Tips on Managing the Newly Purchased Bull Spring 2015. In the 2015 article I wrote that the two main causes of declines in semen quality were heat and stress. By far the most common cause of heat is fat in the neck of the scrotum. Fever, local inflammation, hernias and extremely hot weather are much less prevalent. Feeding high energy diets from pre-weaning up to the yearling stage doesn't appear to result in as much scrotal fat accumulation compared with feeding similar diets after 16 to 18 months of age. Breed and genetic line probably influence where and how fat is laid down as much as anything. British breeds, or British breed-based cattle; particularly, Herefords and Speckle Park are more prone to scrotal fat accumulation. Angus accumulate fat in the scrotal neck and also under the skin of the entire scrotum causing the testicles to look plump with almost no scrotal neck. The temptation to overfatten bulls for sale as two-year olds is the root cause of many problems - obesity has also been linked to poor sex drive, lameness and premature culling. Advantages assumed by buying a two-year old over a yearling bull can easily be lost due to overfeeding.

Stressors associated with increases in sperm abnormalities have to be of at least 3 or 4 day duration. Persistent pain from lameness or fighting injuries, bad weather, or perhaps dehorning have all been demonstrated to cause substantial declines in the proportion of normal sperm due to stress. The appearance of sperm exhibiting the distal midpiece reflex appear first and may be the only abnormality in cases of mild, short-lived stressors. Sperm exhibiting the distal midpiece reflexes can appear in substantial numbers and almost completely disappear within as short as a 3 week window. More severe or long-standing stressful events will result in the appearance of different sperm defects arriving in the sperm picture in a sequence dictated by where the defect occurred in the sperm production process. Very long standing stressors such as a bad foot rot continue to affect many stages along the sperm production process; therefore, a number of different sperm defects will be present; for example: distal midpiece reflexes; proximal droplets; pyriform heads and nuclear vacuoles.

Other causes of poor sperm morphology include genetics, toxins, season, puberty and nutrition. There are a few inherited sperm defects such as the Dag defect and the Tail Stump defect where high numbers of sperm are affected and a genetic link has been proven. Fortunately these are relatively rare. For many other defects a genetic basis has been proposed, but not substantiated. Complicated modes of inheritance and variable expression of the defect are a large part of the reason that a genetic link remains suspected at best. For instance,several of the abnormal sperm morphologies that are suspected of being heritable when in large numbers, may also appear in small to moderate numbers usually with other sperm defects as a result of some other disturbance of sperm production. The temptation to point fingers at the breeding program, therefore, should not be your first response.

Puberty requires a few to several months to be completed. The onset of puberty is marked by a low sperm concentration and a high proportion of abnormal sperm. Once sexual maturity has been achieved the bull is able to produce a concentrated semen sample and should have greater than 70% morphologically normal sperm. At the onset of puberty there are a variety of sperm abnormalities present including abnormal head shapes, tightly coiled midpieces and proximal droplets. As puberty progresses proximal droplets become the most prevalent abnormality. Proportions of proximal droplets can be as high as 30, 40, 50, or even 60%; usually with a smattering of other defects. By and large, the pubertal sperm picture is the reason for the Decision Deferred category on the Western Canadian Association of Bovine Practitioners (WCABP) breeding soundness evaluation form. This classification implies that the bull will likely have a Satisfactory classification soon, but is not Satisfactory on the day of the test. A Decision Deferred classification doesn't seem as final as an Unsatisfactory, "the bull is no good", classification. Proportions of proximal droplets can decline rather quickly within 3 weeks to a month, so retesting in due time is recommended. Sperm with the proximal droplet are not capable of fertilization and it appears that when there are large numbers of proximal droplets even the normal appearing sperm have poor fertilizing potential. Using a bull with high numbers of proximal droplets for breeding has been proven to result in low conception rates. Puberty and scrotal circumference are closely related with bigger testicles being predictive of puberty beginning at an earlier age. Bulls with large scrotal circumferences and pubertal sperm pictures, i.e. proximal droplets, likely are experiencing prolonged puberty. A pubertal sperm picture is not a "rusty load". The "rusty load" term was coined for bulls that accumulate, or build up sperm in their tubular duct system. These are usually older bulls that continue to store sperm during periods of sexual rest rather than clean out old sperm daily with urination. The typical scenario at semen testing is a large volume of semen (30 plus mL), containing lots of dead sperm with detached heads.

Although cattle can breed year round there is a seasonal effect on sperm production which is especially evident in northern climates. More bulls will fail their semen test during the winter and early spring months than during the late spring and summer. This can be problematic for those hosting early spring bull sales. Seasonality may also be confounded by nutrition – feed quality in the winter often falls short of lush summer pasture. Seasonal/ nutritional sperm pictures usually present with a smattering of defects with some bulls being more affected than others.

With bull sale season peaking in March and turnouts on many commercial operations not occurring until mid-June to mid-July there are many circumstances that can have a negative effect on sperm quality. Over the last couple of years I have had the opportunity to retest more than a few bulls within a few to several weeks after delivery to their new homes. A few, probably less than 5%, of these bulls fail my breeding soundness evaluation due to poor semen quality. Two things that must be kept in mind is that: 1) a breeding soundness evaluation is only a snapshot in time; many things can happen after that; and 2) stress can have a negative effect on semen quality that is variably expressed amongst individuals. Many years ago I was freezing semen on a fancy show dog that sired many litters, but I could never collect a freezable quality sample while he was being shown. My best advice for bull buyers is to try to minimize stress amongst your newly purchased bulls. Branding, fighting, protection from inclement weather, nutrition (feed, minerals, vitamins, water quality and quantity), and even new surroundings can all be sources of stress for your bulls. I suspect that these stressors are even worse for yearling bulls and akin to the stress of weaning. If stress in inevitable allow enough time for your bulls to acclimate before retesting, say 2 or 3 months.

In closing: Don't just think about bull management think of yourself as a manager of semen production and distribution!