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ONE MORE

Experts share tips for applying strategies to improve reproductive success at Tennessee symposium.

by Troy Smith, field editor

The Making of a Calf

Lannett Edwards claims she never tires of witnessing the birth of a calf and thinking about all that goes into the process. Of course, as a reproductive physiologist at the University of Tennessee (UT)–Knoxville, it's Edwards' job to think about the bovine beast's reproductive process. It's also part of her job to think about the factors that may impede its success.

Working in a state where no more than 80% of all beef cows wean a calf each year, she's spent a lot of time pondering the reasons — especially reasons why a cow or heifer might not become pregnant in the first place.

Speaking at the 2019 Applied Reproductive Strategies in Beef Cattle (ARSBC) symposium, hosted Aug. 20-21 in Knoxville, Tenn., Edwards said she had no doubt most beef producers realize that a calf is the result of an oocyte (egg) from a cow being fertilized by a spermatozoon (sperm cell) from a bull. However, she said, the "pilgrimage" of gametes to the site of fertilization and the production of an embryo competent to progress throughout pregnancy may be taken for granted.

Edwards reviewed the reproductive anatomy of the cow, focusing on the ovaries and noting that the total number of oocytes a female is capable of producing are made during early fetal development in her dam's uterus.

Discussing the bull's reproductive system, Edwards explained that it takes two months to complete spermatogenesis, or the production of a sperm cell. But sperm are not capable of fertilizing an oocyte until after "capacitation," a process occurring after sperm is deposited within the female and while traveling through the oviduct.

The male and female components undergo incredible journeys even before fertilization occurs. Of the billions ejaculated, as few as 100 spermatozoa actually reach the site of fertilization. Only one will fertilize the oocyte.

"Afterward, lots of things can still go wrong," said Edwards.

After summarizing the processes leading to fertilization and formation of the resulting zygote, Edwards described the cellular divisions and early development of embryo and placenta. She explained how maternal recognition of pregnancy occurs around 16 days after breeding. A fetal heartbeat is detectable at about three weeks, and fetal attachment is typically complete after four weeks. After 50 days or so, the fetus is recognizable as a "calf."

As producers implement management strategies for achieving a 90% calf crop or better, it's useful to have an appreciation for the "pieces and parts" involved in the making of a calf.

"Considering the processes involved," she added, "it's really amazing that we have the success that we do."

Fetal protection

For a lot of reasons, the gestating fetus is the most at-risk creature on any cow-calf operation. A fetus is a fragile thing, susceptible to infection by a variety of pathogens that can ultimately end a pregnancy. Abortion often comes as a surprise, though, because pathogens that cause fetal disease and abortion may not cause the dam to exhibit prior symptoms. In some cases, the loss of the calf is the first sign of a problem.

However, according to UT veterinarian Marc Caldwell, the dam definitely is involved. Talking about reproductive health, Caldwell explained how pathogens must first infect and replicate in the pregnant cow before infecting her fetus.

"We might think of the cow as the protective shell. She is the barrier between pathogens and the fetus, and we want to strengthen that barrier by practicing immunization (through vaccination) and biosecurity. But biosecurity trumps the best vaccine immunity," stated Caldwell.

Noting that many health problems are purchased, Caldwell reminded the audience that new animals brought to an operation should be kept separate from the home herd for a time to make sure they are not carrying disease. Advocating care and sanitation, he called human and vehicle traffic frequently overlooked ways that disease may be spread between operations, or between different groups of animals on the same operation.

Caldwell discussed vaccination, reminding producers that disease immunity can be impeded by poor timing of vaccination, poor vaccine handling or administration, poor

immunocompetence of individual animals or the potential for overwhelming disease pressure. Explaining the difference between "modified live" and inactivated, or "killed," vaccines, Caldwell said the type of product used also shapes the immune response.

"Modified-live [virus] (MLV) vaccines are very effective, but they are not 100% safe. You are giving the animal a 'tame infection' to start an immune response," said Caldwell, explaining that use of an MLV in pregnant naïve females may induce abortion. "Killed vaccines are safe for use in pregnant females, but not as effective."

Acknowledging the controversy regarding appropriate choice of product, Caldwell talked about a relatively new lifetime immunization model called "prime-boost," which incorporates both MLV and killed vaccine products. Immunity is primed by using an MLV product first, in young nonpregnant animals. An initial MLV dose could be administered at weaning, followed by the recommended second dose administered three to four weeks later. Thereafter, annual booster injections are given, using a killed vaccine. Caldwell said studies suggest the method produces levels of immunity beyond what can be obtained through the use of only one type of vaccine.

Caldwell also advised producers to become familiar with diseases that may cause reproductive loss, and particularly those diseases that may be prevalent in their geographical region. Such knowledge is helpful in planning for immunization of the herd. He urged careful consideration of an appropriate vaccination program and due diligence regarding biosecurity.

Valuable connections

The very survival of a bovine fetus is totally dependent on one good connection — that shared with the placenta. According to UT veterinarian Andi Lear, the placenta comprises only six layers of epithelial cells, but they are mighty important.

"The placenta is an organ that is pretty amazing. It does so many things," said Lear. She explained that after 50 or so days of gestation, the placenta is responsible for maintaining a pregnancy, nourishing the fetus, producing hormones, modulating maternal immune response and more.

"There is a lot of interaction between maternal and fetal cells via the placenta," Lear added, emphasizing the importance of placental health.

Lear talked about methods for assessment of reproductive efficiency and placental health, first explaining how blood protein analysis is being evaluated as an indicator of embryonic/fetal viability and placental health. She noted how pregnancy associated glycoproteins (PAGs) produced by the placenta are the basis for reliable pregnancy in ruminants. Commercial assays are available for detecting PAG concentrations in both maternal blood and milk. Lear said PAGs also seem to be predictive of the ability to maintain pregnancy.

Evidence suggests that maternal blood PAG concentrations are lower in cattle likely to undergo embryo or fetal loss. However, the opposite is true for cows that are recipients of somatic cell nuclear transfer-derived (cloned) embryos. Among those recipient cows, higher blood PAG levels may indicate greater risk of pregnancy loss.

"I think this is a hot area of research for the future," stated Lear, expressing hope that measurement of placental products, like PAGs, can serve as a noninvasive marker of placental health and possibly indicate the occurrence of fetal mortality.

The 2019 ARSBC symposium was hosted Aug. 20-21 by UT and the Beef Reproduction Task Force in Knoxville, Tenn. Full coverage, including the accompanying proceedings, slides and video, is in the Newsroom at *www.appliedreprostrategies.com*.