Continuing the Discussion on Negative Energy Balance and Fertility

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The high producing dairy cow is a marvelous high-octane beast who can turn feed into large amounts of nutritious milk. One downside is it often harder to get her pregnant compared to her lower producing herdmates and heifers. In a previous article, we chatted about how the development of the oocyte can be a factor in why high producing cows who experience negative energy balance can be harder to get pregnant. In this article we will discuss the influence negative energy balance has on fertility during the early days of embryo development.

Most early lactation high producing cows are in negative energy balance because the demand for energy exceeds the energy the cow is able to consume. The result is body fat is mobilized to provide the extra energy. Blood concentrations of free fatty acids are elevated when cows are mobilizing body fat to support milk production.

In the previous article we discussed when free fatty acids are elevated in the blood they are also elevated in follicular fluid which may result in a compromised oocyte. At ovulation the oocyte is released from the follicle and relocates in the oviduct where it is fertilized and spends four days before it migrates to the uterus. Therefore, the environment in the oviduct is also of interest.

Results of recent research have shown that cows with elevated free fatty acids in the blood also have elevated levels in the oviductal fluid. It appears elevated free fatty acids in the oviduct do not have a negative impact on sperm motility, storage, capacitation or the process of fertilization. On the other hand, early development of the embryo is negatively influenced by elevated free fatty acids. The exact mechanisms are beyond the scope of this article.

Most studies on early embryo development are done in a laboratory using cell culture techniques. These studies show clearly that the pre-implantation embryo is very sensitive to less than perfect metabolic conditions in the culture media. We can extrapolate that a similar thing happens in the live animal.

The next stop in the embryo journey is the uterus where it must implant to result in a full-term pregnancy. The timing of the many maternal-embryonic interactions during the first few days in the uterus are very important. Anything which messes with the preparedness of the uterus or the maturity and quality of the embryo can result in failure to conceive. In fact, most oocytes are successfully fertilized, but many die during the first seven days after insemination and many

more die between days 7 and 16. In addition, many embryos are viable at day 16, but are not mature enough to send a strong enough signal to the dam that they are present. The result is the cow is pregnant but does not know it and prostaglandin is released from the uterus which kills the corpus luteum, the progesterone level drops quickly, and the pregnancy is terminated. This same thing happens during heat stress.

In conclusion, there are many things which can compromise the oocyte and early stages of embryo development. One of the big factors in the high producing dairy cow is the elevated level of free fatty acids. It is also evident that when the oocyte is compromised in the follicle that damage cannot be repaired. We need to minimize the magnitude and duration of negative energy balance in the high producing early lactation cow. There are thousands of articles written on how to manage transition and early lactation cows to accomplish this goal, so I will not enter that discussion here.