Periparturient immune suppression in dairy cows

Niall Jackson MVB MSc, ruminant technical consultant – Ireland, Elanco Animal Health, outlines how to maintain dairy cow health during the critical early lactation period

Early lactation is a well-recognised risk period for a range of diseases in both dairy heifers and cows. In Ireland, with a focus on a tight calving pattern during spring to utilise grass growth, there are increased demands on farmers and veterinary surgeons to treat these diseases which are often referred to as transition diseases. Conditions that often occur during this time include milk fever (hypocalcaemia), mastitis, retained foetal membranes (RFM), metritis, ketosis and displacement of the abomasum. The transition period, which encompasses the commonly used 60-day dry period and the first 30 days in lactation, can now be referred to as 'the vital 90 days'. This emphasises the critical importance of this period in terms of cow health, longevity, productivity, antibiotic use and future fertility.

IMPACT OF PERIPARTURIENT IMMUNOSUPPRESSION

A key part of managing transition disease is to evaluate the impact of periparturient immunosuppression on our dairy animals as they calve and begin to produce milk. Significant nutritional, social, physiological and environmental changes are occurring in this part of the cow's production cycle, all of which can impact on the immune system of the heifer or cow. It has been found that up to 44% of cows are deemed unhealthy within the first 60 days in milk (DIM).[1] Research here in Ireland also supports this observation as it has been argued that the incidence of transition disease in Ireland remains unacceptably high.[2] Clearly the immune system has a key role to play in combating disease in this challenging period but why do cows experience periparturient immunosuppression?

Immune-system dysfunction has been demonstrated to contribute to several of the diseases referred to earlier including mastitis, RFM and metritis.[3,4] This down regulation of the immune system is found in many mammalian species around parturition hence why increased susceptibility to disease is observed in dairy cattle during this time.

Innate immune responses are activated by the primary incursion of invading pathogens and also by tissue injury,

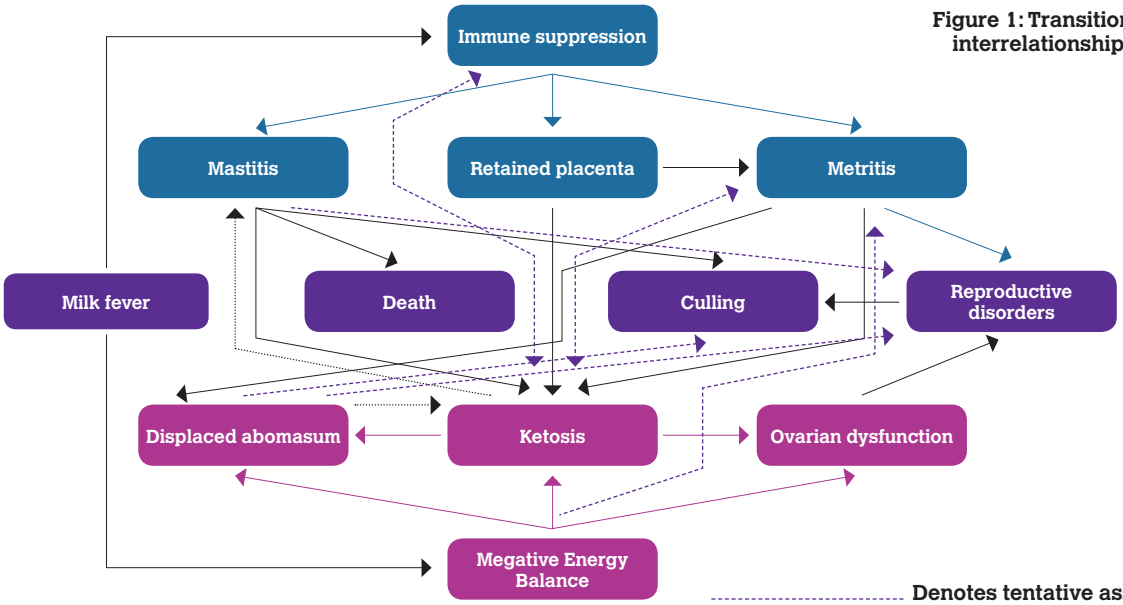

Figure 1: Transition disease interrelationships.[4,9,10,11,12]

whereas the acquired or adaptive immune response mediated by memory cells is to prior exposure of particular pathogens. Anatomical immunity is important around calving as the teat sphincters and cervix become open allowing for possible pathogen invasion into the udder and uterus respectively. Why this reduction in immune response occurs and how it is modulated is not well known but, it may be a result of endocrine changes occurring close to calving, including those to cortisol, reproductive hormones, growth hormone, insulin and IGF-1.

IMPORTANCE OF NEUTROPHILS

The down regulation of the adaptive or acquired immune system is thought to be necessary to allow an appropriate immune response during parturition. However, the innate immune system is also affected in the weeks pre and post-

partum. For example, several studies have demonstrated that neutrophil function in dairy cows becomes impaired during the periparturient period, and this effect is greatest in cows that later develop mastitis and metritis.[5] Neutrophils are the key component of the innate immune system accounting for the majority of innate immune function in body tissues such as the udder. They also play a major role in the expulsion of the placenta which is of foetal origin. Neutrophils are crucial to the successful expulsion of the placenta within 24 hours of parturition. RFM (>24 hours) is thought to be due to the failure of placentome degradation mediated by the immune system at the end of pregnancy.[6]
It has also been suggested that up to 50% of cows experience one or more of the following reproductive tract pathologies post-calving: metritis, purulent vaginal discharge, endometritis and/or cervicitis.[7] The innate immune system is responsible for tackling the inevitable bacterial contamination that occurs within the reproductive tract following calving. Having greater numbers of neutrophils in uterine cytology samples at day seven post-partum has been found to increase the risk of pregnancy by day 150 post-partum.[8]
In terms of the complex interrelationship between immunosuppression, negative energy balance and hypocalcaemia (see Figure 1), hypocalcaemia has been shown to affect the functionality of both neutrophils and other immune cells.[14] Sub-clinical and clinical milk fever can also have an indirect effect on immunity via significantly increasing the risk of ketosis and fatty liver. Prolonged high levels of non-esterified fatty acids (NEFAs) and ketone bodies such as beta-hydroxy butyrate (BHB) also impact on neutrophil function thus exacerbating the disease state of these cows and heifers where metabolic issues are poorly managed.

WHAT CAN WE DO TO MINIMISE THE IMPACT OF IMMUNE SUPPRESSION IN THE PERIPARTURIENT PERIOD?

It is imperative to address any management problems on individual farms which can exacerbate the nutritional, social, physiological and environmental changes that cows and heifers undergo before and after calving. Minimising stress can avoid prolonged elevated levels of endogenous cortisol which can result in depressed chemotaxis, margination and phagocytosis of neutrophils.[13]
Close attention to animal movements and their environment around calving are important to reduce stress and the potential for a negative impact on dry matter intake.
It is also worth ensuring that nutritional and mineral supplementation strategies are optimal. Reducing the severity and duration of negative energy balance within the Vital 90 Days along with minimising hypocalcaemia is also recommended. Reducing the risk of pathogen exposure by encouraging hygienic practices is worthwhile especially in the context of a tight calving pattern whereby attention to detail may suffer as the calving season progresses.
Adopting innovative and novel preventative solutions for addressing immunosuppression is also recommended. The use of products which act to restore the innate immune system during the periparturient period can be a valuable tool for farmers who are seeking to address the impact of immune suppression on their farms as part of the overall management strategy.
Reducing the incidence of transition diseases such as clinical mastitis can lead to productivity, fertility and health benefits for the herd thus improving farm profitability while reducing the need for reactive antibiotic treatments. Minimising periparturient immunosuppression is a critical consideration in helping in this success.

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