One of the major factors contributing to production losses in the equine industry is pathogen-associated reproductive dysfunction. Although it is difficult to place a true value on the economic losses associated with pathogen-induced reproductive dysfunction in the horse due to the varying value of individual animals, the financial loss and emotional stress to horse owners and breeders is significant. Pathogenic organisms are associated with poor reproductive performance in the stallion and open and pregnant mare. Thus, the Horse Species Symposium held in Denver, Colorado, on July 15, 2010, at the joint meeting of the American Society of Animal Science, American Society of Dairy Science, Poultry Science Association, Asociación Mexicana de Producción Animal, and Canadian Society of Animal Science targeted 3 areas of significance: 1) contagious equine metritis (CEM), 2) identification of pathogens associated with endometritis and chronic endometritis in the mare, and 3) pathogen invasion during uterine infection leading to premature birth in mares. The primary goal of the symposium was to give an update on these 3 areas of concern and what progress has been made in the management, diagnosis, and treatment of these infectious conditions that have led to reduced reproductive performance in the equine species.

Peter Timoney, from the Maxwell H. Gluck Equine Research Center at the University of Kentucky, assessed the significance of CEM, which has given cause for concern since it was first recognized as a novel sexually transmitted disease of equids in 1977 (Timoney, 2011). This disease of the reproductive tract is caused by the previously unidentified but highly contagious bacterium, *Taylorella equigenitalis*, a coccobacillary or bacillary gram-negative nonmotile bacterium (Platt et al., 1977; Timoney et al., 1977). Contagious equine metritis was initially discovered in the United Kingdom and Ireland in 1977 (Powell, 1978), causing widespread panic internationally within the Thoroughbred industry due to the highly contagious nature of the disease. Whereas CEM is a nonsystemic disease that is restricted to the reproductive tract of both mares and stallions, the clinical signs are only manifested in the mare and are characterized by an acute endometritis, cervicitis, and vaginitis of variable severity together with a mucopurulent vaginal discharge, but rarely results in abortion. Since its emergence, CEM has become more geographically widespread due to the shipment of carrier animals and fresh-cooled or frozen semen within and between countries. Contagious equine metritis is also believed to be endemic in non-Thoroughbred breeds in many countries. Since the initial emergence of the disease in 1978, there have been only a few incursions of note in the United States until December 2008 when the disease re-emerged (USDA, APHIS, 2010), resulting in an extensive epidemiological study that determined the outbreak was more extensive than originally thought. Several significant epidemiological findings emerged from these studies, which identified that 11 breeds were affected and stallions were the primary carrier animals, most of which were exposed to *T. equigenitalis* through the use of contaminated fomites in semen collection centers. The good news is that the pathogen is sensitive to a wide array of antibiotics and good management practices can lead to the eradication of the pathogen. However, Timoney reiterated the challenge facing the equine industry in the United States and the importance of reestablishing CEM-free status.

Two presentations were devoted to better diagnosis and treatment of endometritis. Morten Petersen, University of Copenhagen College of Veterinary Medicine, Denmark, described the use of fluorescent in situ hybridization (FISH) to identify endometritis pathogens in the mare uterus (Petersen et al., 2010). It has been
noted that diagnostic sensitivity and specificity is much improved when using uterine biopsy compared with a swab (Nielsen, 2005). Moreover, localization of pathogens, such as *Streptococcus equi* ssp. *zooepidemicus*, is not possible to determine with the use of swabs. Thus, Petersen et al. (2009, 2010) developed the use of FISH to demonstrate the spatial and temporal distribution of bacteria within the infected endometrium. These investigators noted that the distribution of pathogens in endometrial tissues from experimentally infected mares was primarily in the luminal epithelia, whereas in chronic uterine infections of mares the pathogens were localized below the epithelial lining, within the endometrial crypts, or deep in the stratum compactum, but never at the luminal epithelium. This is an interesting observation because the investigators go on to explain that such mares treated with pathogen-sensitive antibiotics still provide biopsies that demonstrate the presence of *Streptococcus equi* ssp. *zooepidemicus* using FISH. Based on these findings, the authors recommend that mares presenting with chronic uterine infections be treated with antibiotics with a capacity to penetrate cell membranes for greater drug efficacy.

The second talk on endometritis was presented by Mary Beth Stanton, on behalf of Michelle LeBlanc of the Rood and Riddle Equine Hospital in Lexington, Kentucky, and focused on other diagnostic approaches for endometritis, including culture of uterine biopsy tissue or small volume uterine lavage (LeBlanc, 2010). In addition, based on recent evaluations of treatment regimens, recommendations were made on how to best manage mares with chronic endometritis (LeBlanc et al., 2007; LeBlanc, 2009). These included uterine lavage 1 h before breeding, cloprostenol treatment postbreeding, cervical dilators, intrauterine chelators (i.e., Tris-EDTA), mucolytics (i.e., dimethyl sulfoxide, kerosene, n-acetyl-cysteine), corticosteroids (i.e., dexamethasone, prednisolone), and immunomodulators (i.e., cell wall extracts of *Mycobacterium phlei* and *Propionibacterium acnes*). Some of these agents have proved to be effective therapies and offer alternatives to repeated use of antimicrobial agents, which tend to contribute to antibiotic resistance (LeBlanc, 2009).

Pathogen-induced preterm birth, with a particular emphasis on pathogen invasion during uterine infection, was the focus of a presentation given by Peter Ryan, from the Department of Pathobiology and Population Medicine at Mississippi State University (Ryan et al., 2011). This presentation discussed the development and application of a novel approach, whereby transgenically modified bacteria transformed with *lux* genes and biophotonic imaging were utilized to better understand pathogen-induced preterm birth in late-term pregnant mares (Ryan et al., 2011). An advantage of this technology over standard diagnostic techniques is that it allows for the potential tracking of pathogens in vivo in real time and over time. Although the application of this technology is in its infancy in domestic animals, investigators were successful in identifying the fetal lungs, sinuses, nares, urinary, and gastrointestinal systems as primary tissues for pathogen invasion after experimental infection of pregnant mares with *lux*-modified *Escherichia coli* (Ryan et al., 2010). Importantly, pathogens were not detected in other vital organs such as the liver, brain, and cardiac system. Such precision in localizing sites of pathogen invasion provides potential application for this novel approach in the development of more targeted therapeutic interventions for pathogen-related diseases in the equine and other domestic species.

In summary, these presentations provided an informative update on the progress that has been made in recent years to improve the management and understanding of pathogen-induced reproductive dysfunction in the equid species. Insights on prevention of CEM, better diagnosis and treatment of mares presented with endometritis, and new information on the localization of pathogens associated with preterm delivery and abortion were presented. Although much progress has been made in these areas, it is clear that challenges still lay ahead, in particular the increasing threat of bacterial resistance to antibiotics.

**LITERATURE CITED**


