Research article

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Recent advances and future approaches for diagnosis, treatment and management of endometritis in dairy herds

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High reproductive performance is a decisive factor for production and, hence profitability in modern dairy herds (2). Although endometritis includes clinical and Cytological endometritis (CYTO) or subclinical endometritis (SCE) is highly prevalent, asymptomatic uterine disease in dairy cows can have numerous negative impacts on the reproductive performance and economic efficiency of the farms, such as reduction in the pregnancy per insemination (P/AI), extension in calving to conception intervals, Infertility by disrupting uterine and ovarian functions and increase in culling rates (40; 37,23,30). Endometritis can be defined as the superficial inflammation of the endometrium (no deeper than the stratum spongiosum) (8). The proportion of animals affected varies widely among studies, ranging from approximately 11% to more than 40% (39). Diagnosis of endometritis can take place by ultrasonography, endometrial cytology, and uterine biopsy (3,37). It is well-accepted that the most convenient method to diagnose cytological endometritis is by measuring the polymorphonuclear (PMN) percentage in endometrial cytology samples. The suggested threshold value for polymorphonuclear cells (PMN) as diagnostic for cytological endometritis depends on the time postpartum and varies from 5% to 18% (39).

However, lower threshold (≥6%) values have also been used when cytobrush samples were collected 35 Days Postpartum (10). Various treatments have been suggested for the treatment of cytological endometritis, including the use of hormones (PGF2α), antibiotics (general or topical), disinfectants, proteolytic

enzymes, uterine lavage, and herbal extracts.However, the use of PGF2α in the treatment of endometritis and cytological recovery is controversial since some researchers believe that PGF2α treatment does not affect cytological endometritis recovery (6,24).

Despite the undeniable detrimental impact of uterine diseases on fertility outcomes, culling risks, lactation performance, and sustainability of dairy operations (5,24,25,26), its diagnosis, treatment, and prevention remain inconsistent (12). A recent survey of 45 farms in California revealed that there is a significant disparity in which criteria are used to diagnose and treat metritis and endometritis (12), a concerning situation when considering the global threat of antimicrobial resistance dissemination and World Health Organization guideline on the use of medically important antibiotics (42). The situation of endometritis is even more daring with many farms performing no diagnosis and a complete absence of efficacious therapy in places such as the US market (19). On the other hand, a myriad of research advances shed light on how uterine diseases may disrupt endocrine signaling, oocyte, follicle and embryo development, and the uterine environment (29,31,34). The understanding of uterine diseases microbiome also had tremendous progress and created opportunities for the development of novel preventives to improve the management of uterine diseases (15,16,20,35). Indeed, in the last decade, over a dozen non-antimicrobial therapeutics to prevent and treat metritis and endometritis have been investigated with encouraging results (1,2,32) and some Tamied Artificial breeding has shown acceptable fertility even for subclinical endometritis (14,24). Genome-enable prediction for health traits (27,28), activity monitors (4,38), biomarkers (4,9,41,43), immune cells profile (33), machine learning predictive models (7) are others innovative tools that have been explored in the recent years to help mitigate negative impacts of uterine diseases. The objective is to summarize recent advances and future directions for uterine disease diagnosis, pathogenesis, and management (13).

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