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RESEARCH ARTICLE

Examining the Unregulated Use of Hormonal Preparations in Animal Reproduction

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ABSTRACT

Hormones play a pivotal role in addressing diverse reproductive disorders in domestic animals, with their prevalence surpassing antibiotics in daily veterinary practice. Hormonal preparations are frequently administered to restore animals' reproductive capabilities, contingent upon precise diagnostic procedures. It is imperative to eschew the indiscriminate utilization of hormones, which may serve as a facade for managerial issues or purportedly enhance production performance. To ensure optimal breeding outcomes, meticulous records of diagnoses and treatments must be maintained. Inappropriate use of pharmaceutical preparations for manipulating breeding cycles, especially when not administered in accordance with veterinary guidelines, should be discouraged due to its potential to significantly reduce the overall fertility of breeding stock. Rather than relying on hormones for the treatment of reproductive ailments, the adoption of sound management practices is advocated to enhance animal health and fertility. Furthermore, consumer interest in animal health and welfare is on the rise, coinciding with ethical concerns regarding the utilization of hormones in animal reproduction. This review comprehensively addresses the indiscriminate use of hormonal preparations in animal reproduction.

Keywords: Animal reproduction, Endocrine disruptors, Hormones, Infertility

INTRODUCTION

The reproductive efficiency significantly influences the profitability of livestock operations, particularly in commercial dairy herds. Traditionally, the foremost objective of farmers in most countries has been to ensure that each cow gives birth to a calf approximately every 12 months. One beneficial approach is to voluntarily extend the interval between calving and the first service, subsequently elongating the calving interval. This strategy can enhance the fertility of high-yield cows, affording them more time for post-calving recovery. As a result, the reliance on hormonal treatments to address anoestrus is reduced, along with the number of inseminations required per cow (Larsson and Berglund, 2000).

Hormones like Gonadotropin-Releasing Hormone (GnRH) and prostaglandins, have been widely acknowledged as significant targets for fertility control and management in female animals (Herbert and Trigg, 2005; Inskeep, 1973). Comprehensive data encompassing conception rates, optimal dosage regimens and administration routes, timing of insemination post-treatment, potential adverse effects, and the utilization of alternative hormonal analogues are imperative for efficient fertility management protocols. While these hormonal interventions offer established clinical advantages, it is crucial to recognize that inappropriate dosages of

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hormonal preparations can lead to adverse clinical outcomes, potentially causing non-compliance and diminished therapeutic efficacy. Hence, a thorough understanding of the optimal hormonal balance and precise administration strategies is paramount for successful fertility management in female animals.

Hormonal Preparations in Animal Reproduction

Reproductive hormones, originating from both the anterior pituitary gland and the gonads, play a pivotal role in regulating reproductive function and are equally indispensable for diagnosing associated disorders. Estrogen, a primary female sex hormone primarily produced by the ovarian follicles and corpus luteum, as well as the placenta (Cui *et al*., 2013), plays a crucial role in the development of female sex organs, regulation of gonadotropin secretions, stimulation of uterine epithelial cells, growth of blood vessels, and development of endometrial glands (Yu *et al*., 2022). Progesterone, released by the ovaries and the adrenal glands, serves as the precursor for estrogens and androgens, aiding in the regulation of the estrous cycle and the maintenance of pregnancy (Sangsritavong *et al*., 2002). Gonadotropin-Releasing Hormone (GnRH), secreted from the hypothalamus, stimulates the pituitary gland to secrete Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH). FSH plays a vital role in ovulation by stimulating follicular growth and estrogen secretion in synchrony with LH. LH, on the other hand, plays a crucial role in follicular maturation, rupture, and ovulation. Estimating LH and FSH levels is of prime importance in diagnosing disorders related to the normal reproductive cycle and fertility (Manocha *et al*., 2018).

When diseases impact the reproductive performance of individual animals or groups, it is widely acknowledged that effective treatments, if available, should be employed. In pursuit of farmers' objectives, hormones serve as vital remedies for treating reproductive diseases. Hormones, in particular, are crucial tools for managing breeding. A prevailing trend in most countries is the expansion of herd sizes. In large herds, artificial insemination (AI) necessitates rigorous estrus detection, demanding substantial labor (Reith and Hoy, 2018). To streamline this process, synchronization of estrus and ovulation is advocated, achieved through the use of various hormones such as progesterone, oestrogen, prostaglandins, gonadotrophin-releasing hormones (GnRH), and human chorionic gonadotrophin (HCG), either individually or in combination (Cavalieri *et al*., 2022; Garcia-Ispierto *et al.,* 2021). Exogenous luteinizing hormone (HCG) and gonadotrophin-releasing hormone (GnRH) are administered to induce ovulation in cases of delayed ovulation relative to estrus and insemination (Jaswal and Singh, 2013). GnRH has also been employed during the luteal phase of cows to stimulate the corpus luteum (Sheldon and Dobson, 1993). Additionally, progesterone administration has been utilized in repeat breeder cows to support progesterone levels during early pregnancy (Sreenan and Diskin, 1983). These treatments are employed to expedite the onset of puberty or reduce the interval between calving and conception. In cases of retained placenta, prostaglandins are sometimes used and have been demonstrated to reduce the incidence of the condition in cows induced to calve with corticosteroids (Gross *et al*., 1986). Uterine motility-boosting drugs like oxytocin are also employed. Prostaglandins are commonly administered in pyometra and endometritis cases to induce corpus luteum regression, followed by follicle maturation and estrus, ultimately leading to uterine contractility (Douglas and Ginther, 1973). Corticosteroids, either alone or in conjunction with prostaglandins, are used for parturition induction (Adams and Wagner, 1970). Furthermore, the embryo transfer program relies on the extensive use of hormones to synchronize estrus and superovulation.

Unregulated use of hormones and its consequences

Exogenous substances or hormonal preparations that disrupt normal endocrine function are classified as endocrine disruptors (Zoeller *et al*., 2012). These substances are known to interfere with various hormonal and metabolic processes, affecting the activation, secretion, synthesis, release, and binding of normal hormones (Arsenescu *et al*., 2008). The administration of exogenous hormonal preparations can disrupt normal hormone-receptor interactions through various mechanisms. These preparations may mimic hormones, triggering inappropriate responses at inappropriate times, or block hormone action, resulting in alterations in both hormonal and homeostatic systems (Gore *et al*., 2015). Chronic exposure to these agents has been associated with detrimental effects on the development of endocrine tissues and reproductive systems (Martyniuk *et al*., 2020; Segner, 2009). The documented adverse effects of endocrine

disruptors encompass infertility, cancer, irregular reproductive cycles, disturbances in folliculogenesis and ovulation (Gibson and Saunders, 2014; Nash *et al*., 2004). Imbalances in Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH) levels can lead to various reproductive disorders, including cystic ovaries, ovulation failure, delayed ovulation, and infertility (Manocha *et al*., 2018). Specific hormonal alterations, often induced by the unnecessary administration of exogenous progesterone, Gonadotropin-Releasing Hormone (GnRH) analogs like Buserelin or Gonadorelin, as well as prostaglandins such as Cloprostenol, Dinoprost, Tiaprost and Luprostiol can significantly impact fertility. These hormonal shifts can lead to irregular estrous cycles and an elevated risk of reproductive tract infections, often characterized by increased progesterone concentration and reduced estradiol levels (Miller and Hunt, 1996). It's crucial to note that the administration of progesterone has been linked to an increased incidence of mammary, ovarian, and uterine tumors in experimental animals (Galbraith, 2002). Additionally, fibroadenomatosis, a noncarcinogenic tumor of the mammary gland seen in cats, is a progestagen-mediated disease (Hoffmann and Schuler, 2000). Melengestrol acetate (MGA), an orally administered progestogen, is a synthetic steroid used as a feed additive and for estrus synchronization. As a xenobiotic anabolic agent, MGA is associated with the potential for endocrine-disrupting activity (Schiffer *et al*., 2001). The adverse effects associated with the inappropriate use of hormones are illustrated in Figure 1.

Regulatory Framework and Challenges

Comprehensive record-keeping of treatments is essential on every farm, serving multiple critical purposes. Firstly, it enables continuous herd monitoring, allowing for the early identification of disease trends, potential outbreaks, and health issues. Secondly, it provides valuable data for informed breeding decisions, aiding in the selection of animals with improved genetic traits related to health. Thirdly, it contributes to disease population statistics, enhancing our understanding of prevalence, transmission patterns, and risk factors within the herd, including environmental influences. Accurate and thorough recording of inseminations and treatments is of utmost importance, facilitating the incorporation of fertility and health traits into a comprehensive breeding program (Refsdal, 2000). To promote animal health and welfare, the use of synthetic substances or hormones should be minimized and reserved for genuine necessity. Routine treatments of reproductive disorders with synthetic hormonal preparations should be discouraged. Each animal should possess a health card, meticulously documenting diagnosed diseases (Refsdal, 2000). Local veterinarians must rigorously oversee the use of hormonal preparations in animal production, educating farmers about potential adverse effects and ethical concerns associated with unnecessary hormone usage. Promoting awareness and responsible practices are fundamental to maintaining animal well-being, ensuring sustainable farming, and safeguarding food product safety for consumers.

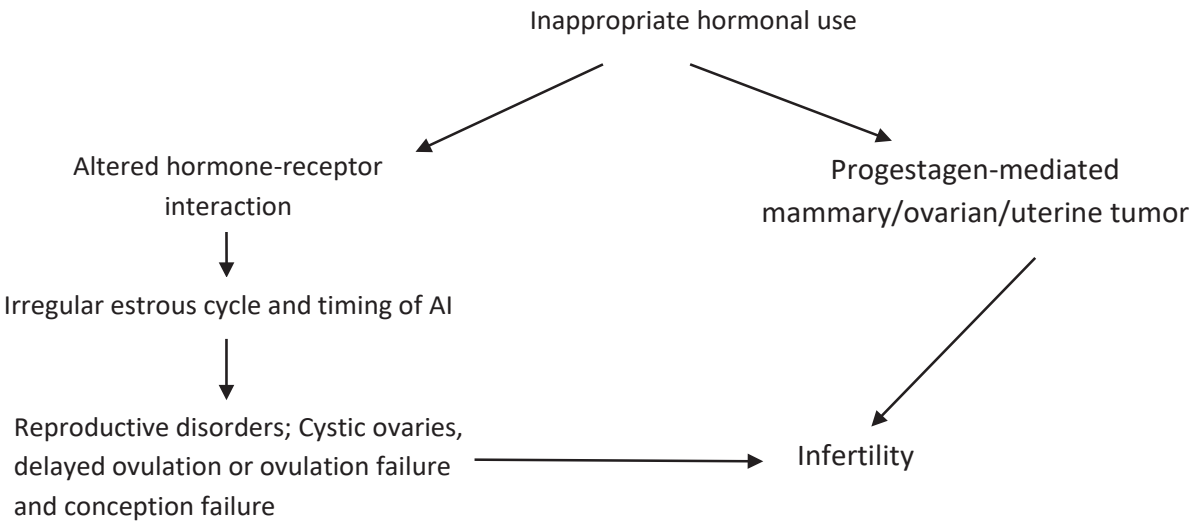

Figure 1. Flowchart depicting undesired effects of inappropriate hormone use

Regulating unnecessary hormone use in animal reproduction is a complex challenge involving various stakeholders—farmers, veterinarians, regulators, and consumers. Challenges include regulatory non-uniformity, difficulty in educating farmers, reluctance to disclose information, and limited affordability and effectiveness of alternatives. Addressing these challenges demands a collaborative effort among governments, researchers, and farmers to develop and implement consistent regulations, promote alternatives, and ensure the responsible use of hormones in animal reproduction.

CONCLUSION

To comprehensively grasp the impact of exogenous hormonal preparations on animal reproduction, extensive research into their mechanisms is imperative. Furthermore, there is a critical need for an extensive array of studies. Promoting awareness and educating farmers and local veterinarians on the advantages and potential risks associated with hormone use in animal reproduction is essential. Effective communication is the key to enabling informed decision-making and instigating meaningful change.

Conflict Of Interest

None.

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