Advances in Biological Research 10 (4): 213-221, 2016
ISSN 1992-0067

DOI: 10.5829/idosi.abr.2016.10.4.104142

Risk Factors of Repeat Breeding in Dairy Cattle

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Abstract: The repeat breeder is an animal that has been breed during three or more successive heat periods without being diagnosed pregnant. Repeat breeding in the cow is the main problem caused by different etiological agents. The etiologies of repeat breeding are numerous and are related to female, male, management factors. The pathogenesis of repeat breeding involves either failure of a fertilization or early embryonic death. For diagnosis of repeat breeding, there are many options, but rectal palpation, ultrasound, hormonal function test and endometrial cytology& uterine bacterial culture are the most important. Even if the treatment of repeat breeding depends on the etiologies, attempts have been made based on the diagnosis. This paper provides a brief review on the repeat breeding cow, with great emphasis given on causes, approaches to diagnosis and remedial measures to solve this problem.

Key words: Dairy Cattle · Early Embryonic Death · Fertilization Failure · Repeat Breeder

INTRODUCTION

Cattle production has been considered as the main component of agriculture development in most parts of sub-Saharan Africa. However the overall conditions of cattle interms of health nutrition management have not matched their contributions to the livelihood and the economies of the peoples in the region. Dairying has been shown to be an important source of income in sub-Saharan Africa, particularly those close to urban centers [2]. Some of the major health problems recorded in many of the farms in Africa have been indicated to the abortions, infertility and cows usually require more than to services to conceive some have remained infertile for years [1].

In Ethiopia, abortion and postpartum reproductive problems such as dystocia, retained fetal membranes and the subsequent endometritis and repeat breeding have been reported to be some of the major problems that a direct impact on reproductive performance of dairy cows. The treatment and handling of the problem at present is based on the experience, skill, knowledge and thoroughness of the diagnostic procedures employed by the veterinarian to arrive at contributing causes for this problem [3].

The Repeat Breeder Cow: Definitions: Repeat breeding (RB), defined as a cow fail to conceive from 3 or 4 regularly spaced services in the absence of detectable abnormalities, is a costly problem for the dairy producer. The repeat breeding causes great economic losses for dairy farmers. The costs of herds management and rearing are increased by increment of expenses of unsuccessful frequent artificial insemination (AI), extended length of the days open (DO) as well as culling and replacement of those cows that can't conceive [4].

Repeat breeding is one of the major infertility problems of herds. The incidence of repeat breeding in dairy cows, worldwide, ranges from 3 to 10%. The potential causes of the repeat breeding mainly include pathological endometritis, nutritional deficiency, specially trace minerals and vitamin A, age of the dam, improper heat detection and endocrine dysfunction [5].

When the function of the reproductive system is impaired, cows fail to produce a calf regularly. Among the major reproductive problems that have direct impact on reproductive performance of dairy cows are abortion, dystocia, retained fetal membrane (RFM), pyometra, metritis, prolapse (uterine and vaginal), anoestrus and repeat breeder. They are classified as before gestation (anoestrous and repeat breeding), during gestation

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(abortion, vagina prolapsed and dystocia) and after gestation (retained fetal membrane and uterine prolapsed) [6].

Physiological Causes of Repeat Breeder: Components of female fertility include ovulation, fertilization and survival of the conceptus through embryonic and fetal development and parturition. Embryonic and early fetal losses contribute significantly to reproductive wastage or inefficiency in dairy cattle. This condition can occur if there is a failure of fertilisation or embryonic death before day 12 of the oestrous cycle (before or at the time of the maternal recognition of pregnancy) [7].

Causes of Fertilization Failure: Potential causes of repeat breeding include sub-clinical infection of reproductive tract [8], age of the animal, failure of estrous detection, endocrine dysfunction, nutritional deficiencies and others. The preovulatory follicle size is correlated with fertility in cattle and it has been postulated that the implementation of management to optimize the size of the ovulatory follicle could improve the fertility. In many species there is an optimum time of mating, i.e., breeding too early or too late will result in depressed pregnancy rates due to the time of ovulation is asynchronous [9].

Abnormalities in Ovulation: Ovulation is critically dependent on the timing, frequency and amplitude of the hormonal changes. Inappropriate pattern of hormones could lead to atresia or to undue persistence of the dominant follicle (with detrimental effects on the quality of the oocyte). The crucial hormonal event that initiates the ovulatory process is the switch from negative feedback by progesterone and oestrogen to positive feedback by estrogen. A longer estrus-ovulation interval usually appears and premature insemination is then carried out [10].

Anovulation has been reported in 2-16% of repeat breeder cows and it is characterized by prolonged basal progesterone after estrus [11]. The LH release pattern is modified and follicle does not get the stimulus for ovulation to occur. Irregular and delayed ovulations have been associated with asynchrony between estrus and ovulation, asynchrony of LH peak and ovulation, or incapacity for LH release. The LH peak characteristics are altered in RBCs and estrous signs are less intense than in normal cows [12].

Oviduct Obstruction: It is commonly observed that the individual females may be infertile due to a cause which does not involve other animals in a herd. Congenital or acquired genital abnormalities are important cause of infertility. Cows having tubular abnormalities may show repeat breeding of known or obscure etiology which requires to be confirmed by patency testing. Abnormities of the fallopian tubes have been attributed as one of the most important causes of female infertility in all species. Clinical diagnosis by rectal palpation of uterine tube abnormalities is only possible if there is gross enlargement and thickening of the tube or severe adhesion involving the tube [13].

The major causes of oviduct obstruction are stated as follows: Salpingitis which is inflammation of the fallopian tubes due to some infectious cause. Hydrosalpinx is also an affection in which the fallopian tube is filled with inflammatory fluid and is the end result of pelvic infection. Grossly, the fallopian tubes were found distended, elongated and tortuous forming many coils in the mesosalpinx. Ampullary region was more affected. A hydrosalpinx does not have healthy cilia, hence, embryos that find their way into the fallopian tube become trapped and may implant there resulting in a dangerous ectopic pregnancy that needs to be removed surgically [14].

Pyosalpinx refers to presence of pus in one fallopian tube. When both tubes are affected with the accumulation of pus inside, the term used is pyosalpinges. Pyosalpinx is a consequence of pelvic inflammatory diseases (PID) which may be caused by streptococcus and staphylococcus infection. Infections may start from vagina and progress up to the cervix, uterus and to one or both fallopian tubes if not treated early [15].

Causes of Early Embryonic Death: The ability of the very early embryo to develop to the blastocyst (Day 0 to 7 after insemination) is dependent on its inherent ability to develop, as a consequence of oocyte quality, sperm quality and the timing of fertilization, or as a consequence of the uterine environment. Factors such as genetic merit and lactation have their own impact on very early embryo development [16]. Survival of embryo is also affected by nutrition, temperature and heat stress, time of insemination, genital infections and asynchrony, maternal age genetic factors, immunological and endocrine factors [17].

Genetic Defect of Embryo: Individuals inherit their parent´s genetic merit and then chromosomal or genetic abnormalities of parent, or those that occurred during the differentiation process may compromise fertility.Few embryos (less than 10%) exhibit chromosomal or genetic abnormalities and are usually associatd with high inbreeding or aged gametes [18].

Abnormal Environment of Oviducts and Uterus: The uterine environment before Day 7 of service or AI may also be suboptimal for supporting early embryo development in lactating dairy cows. The oviduct of heifer is better able to support very early embryo development compared with post partum lactating cows. Attempts to explain this at present are only speculation, but would reasonably include persistent issues of the post partum uterine environment and involution, all of which strongly suggest that the reproductive tract of lactating dairy cows provides a less favorable environment for very early embryo development than that of heifers, late lactation cows or dry cow [19].

Management Problems and Infertility in Cow: Total quality management is required for optimum production and reproduction. Estrus detection before milking and feeding gave a lower detection rate as compared to after milking and feeding. High grade management with some interventions favors easy detection of heat. Environmental factors such as the use of a bull in the herd; poor nutrition or the loss of the body reserves (negative energy balance); and housing elements (concrete slatted or dirty floors) can affect fertility. However, most studies report the seasonal effect as a major environmental factor affecting fertility. Although heavy rain, strong wind or high humidity can reduce fertility, high temperatures have been strongly linked to low fertility [20].

Endocrine Factors and Overcrowding in Uterus: Endocrine factors/causes play an important role in embryonic death. To understand the influence of endocrine causes on embryo survival and mortality one should be familiar with the structural composition and functioning of corpus luteum and interaction between different reproductive hormones affecting luteal lifespan [21].

For some time, failure of maternal recognition of pregnancy about the time of luteolysis has been considered the main cause of embryo mortality in cattle [22]. The challenge of the elongating conceptus at this time is to produce adequate a concentrations of interferon tau to signal maternal recognition of pregnancy and alter the release of luteolytic prostaglandin F2á from the uterus. Several physiological events can conspire to prevent this from happening successfully. The microenvironment of the uterus plays a leading role in determining embryo quality with concentrations of progesterone, IGF and the presence of pathogenic bacteria affecting the chances of embryo survival [23].

Semen and Incompatibility: Optimal bull fertility (by natural breeding or AI) is necessary to achieve high pregnancy rate and normal calving interval. Semen doses for AI must contain at least 6 million of motile sperm after thawing and fertility drops if sperm concentration is reduced. Currently, frozen semen doses are packed with 15-25 million of motile sperm prefreezing, because around 50% of spermatozoa recover motility after thawing. Semen should have a relatively uniform opaque appearance indicative of high sperm cell concentration [24].

Spermatogenic disturbances caused by elevated testicular temperature resulted in the production of abnormal sperm and that vulnerability of sperm DNA to acid denaturation was positively associated with abnormal shaped sperm. This again, tends to confirm that occurrence of morphologically abnormal sperm can signal chromatin abnormalities and potential incompetence among both normal and abnormal sperm. It also underlines the fact that while female sperm selection appears amazingly strong based upon sperm shape and motility, it is far from absolute in excluding incompetent sperm from accessing the egg [25].

Nutrition of the dam: Selection of dairy cattle for milk yield has linked the endocrine and metabolic controls of nutrient balance and reproductive events so that reproduction in dairy cattle is compromised during periods of nutrient shortage, such as in early lactation. The energy costs to synthesize and secrete hormones, ovulate a follicle and sustain an early developing embryo are probably minimal compared to the energy needs for maintenance and lactation. However, the metabolic and endocrine cues associated with negative energy balance (NEB) impair resumption of ovulatory cycles, oocyte and embryo quality and establishment and maintenance of pregnancy in dairy cattle [26].

When cows experience a period of NEB, the blood concentrations of non-esterified fatty acids increase, at the same time that IGF-I, glucose and insulin are low. These shifts in blood metabolites and hormones might compromise ovarian function and fertility. It has also been reported that energy balance and dry matter intake might affect plasma concentrations of progesterone, which may interfere with follicle development and maintenance of pregnancy [27].

Pathological and Managemental Causes of Repeat Breeding: Endocrine Dysfunction: Hypofunctional CL provokes a decrease of progesterone and affects negatively the fertility. CLs are small and poorly developed, with low progesterone production and LH

peak asynchrony. Therefore, inadequate uterine environment is formed and this increases the abnormalities and the loss of embryos. A diminished response to circulating luteotrophic hormones, may contribute to embryo mortality in subfertile cows [12].

A delayed and diminished post-ovulation progesterone curve has been associated with low conception rates in cattle and a low progesterone curve has been shown to be related to significantly reduced production of interferon-tau by bovine. Anovulation has been reported in 2-16% of RBCs and it is characterized by prolonged basal progesterone after estrus. The LH release pattern is modified and follicle does not get the stimulus for ovulation to occur. The follicle continues growing and releases estradiol, which induces the formation of persistent follicles and delayed ovulation. Also, defective follicle recruitment during the middle- and late-luteal phases has been suggested as a cause of anovulation. An abnormal hormone environment may promote continuous development in the dominant follicle, impairing follicular function and oocyte quality and thus reducing fertility embryos recovered on Day 16 of pregnancy [28].

Genetic or Acquired Defects of Ova: A superior oocyte quality is of paramount importance for successful embryogenesis, especially when dealing with assisted reproduction. A competent oocyte is able to maintain embryonic development to term [29]. Although the culture conditions can impact on the developmental potential of the early embryo, the intrinsic quality of oocyte is the key factor determining the proportion of oocytes developing to the blastocyst stage. Generally oocyte quality is determined by the oocyte's nuclear and cytoplasmic maturation which is attained during its growth in the follicle. Besides nuclear and cytoplasmic maturation, follicle diameter, follicle status, oocyte diameter, cumulus morphology has been reported to be related with the developmental competence of oocytes [30].

Oocyte quality is still a poorly defined characteristic but exposure of oocytes to an unfavorable environment (including heat stress, NEB and disease) up to 3 months before ovulation may have a negative effect on the ability of the oocyte to be fertilised and develop into an embryo [31].

Anatomical Defect of the Genital Tract: The reproductive tract of cow provides a suitable environment for oocyte growth, as well as for sperm transport, fertilization and implantation. Anatomical or functional changes of these structures can drive to gestational failure and infertility. Therefore, it is essential to carry out a proper reproductive assessment for discarding animals with congenital or acquired defects. Oviductal abnormalities, that complicate and frequently inhibit the reproduction, are present in 6-15% of adult cows and can reach up to 80% in those with a history of infertility or repeat breeding [32].

Acquired uterine alterations, as metritis, are critical to the resumption of the normal cyclicity during postpartum period, provoking RBCs. Other non-infectious abnormalities, as uterine degeneration and neoplasia, could also be involved in this syndrome, although their incidence is low. Cervix is a defensive barrier and a sperm reservoir and may undergo structural changes associated with inflammation. Cervical traumatic stenosis and obstruction prolapse of cervical rings, adhesions or functional incompetence can be detected associated with RBCs [33].

Genetic or Congenital Anomalies of the Genital Tracts: Congenital causes of infertility are often inherited. They include developmental abnormalities of the ovaries, oviducts, uterus, cervix, vagina and vulva. Some are lethal; a few have a morphological significance and others a functional significance. Common morphological conditions include ovarian (gonadal) hypoplasia and aplasia, anomalies of the tubular genitalia, hermaphroditism, freemartinism, arrested development of the Mullerian ducts (White heifer disease) and double cervix. However, they are of little significance if an appropriate culling programme is practiced [34].

A congenital disorder may be the result of genetic abnormalities, the intrauterine (uterus) environment, errors of morphogenesis, infection, epigenetic modifications on a parental germ line, or a chromosomal abnormality. The outcome of the disorder will depend on complex interactions between the pre-natal deficit and the post-natal environment. Animal studies indicate that the mother's (and likely the father's) diet, vitamin intake and glucose levels *prior* to ovulation and conception have long-term effects on fetal growth and adolescent and adult disease [35].

Gonadless Condition and Hypoplasia of the Ovaries: Congenital and hereditary form of anestrus is upshot of ovarian agenesis or dysgenesis. Ovarian agenesis or aplasia (absence of ovary) is rare condition and probably crop up due to inherited autosomal dominant gene. Bilateral aplastic or gonadless heifers appear normal until breeding age but fail to show estrus and normal

development of udder at puberty and are sterile. Ovarian dysgenesis has been identified as ovarian hypoplasia and freemartin. Ovarian hypoplasia (incomplete development of ovary) is caused by single autosomal recessive gene with incomplete penetration. It may be unilateral or bilateral. The affected ovary is characterized by lack of primordial follicles reserve either partial (partial hypoplasia) or complete (complete hypoplasia). Bilateral complete hypoplastic females remain in anestrous where as partial hypoplastic animals exhibit estrus, conceive and produce viable calves but transmit this undesirable character to the next generation therefore must be avoided [36].

Infectious or Traumatic Inflammatory Process Affecting the Genital Organs: During the early post partum period, cows experience a period of negative energy balance; marked changes in endocrine, metabolic and physiological status; and an increased oxidative stress. Coupled with the stress of parturition, these all play a role in compromising the immune and inflammatory response [37]. Consequently, high-producing dairy cows may have reduced immune competence and are more susceptible to disease, especially invading pathogens causing mastitis, metritis and other production disease [38].

Uterine contamination with bacteria at parturition or in the following days is unavoidable and normal, with 80–100% of animals having bacteria in the uterus in the first 2 weeks after calving. Many cows deal with this bacterial contamination successfully; however, some cows are unable to resolve the contamination and develop metritis within 3 weeks post partum. More importantly, in 20% of cows, pathogenic bacteria persist for 3 or more weeks, resulting in endometritis. The risk of infection is increased in cows with twins, stillbirth, dystocia or retained fetal membranes [39] and uterine infection has negative consequences for the subsequent establishment of pregnancy. The most common etiological agents encounter in abortion, still birth and delayed recommencement of normal ovarian activity after abortion in farm animals are brucella, actinomyces pyogens, listeria, pasteurela, salmonella, haemophilus somnus and clamydia in bovine [40].

Managemental Deficiencies Including Nutritional Deficiency: The importance of nutrition in all vital processes is indisputable and the qualitative and quantitative differences in the ration in dairy cattle may cause reproductive dysfunctions. Nutritional deficiency and increment of services per cow are linked, because the decrease in food intake, weight and body condition causes endocrine imbalances that affect fertility and other organs or systems. The mentioned nutritional deficiency can also affect the postpartum period, causing delay in the uterine involution and increasing the number of open days. Starvation or low grade feeding of animal for long time increases age at sexual maturity in animals. The manifestations of estrus behavior and estrus detection are also affected by nutritional status of animals. The nutrition was one of the most important factors for conception [41] in animals. Deficiency of vitamin and minerals (Vitamin A, E & Selenium) could be the cause of deterioration in sign and symptoms of estrus [42].

High producing dairy cows require sufficient nutrients to facilitate the dramatic increases in energy requirements for milk production that peaks 4–8 weeks post partum. This requirement is only partially offset by increased feed consumption (due to limitations in intake and appetite), with the remainder being met by mobilization of body reserves, resulting in animals entering negative energy balance [43]. The physiological consequences of NEB are loss in body condition score as body reserves are mobilized; low circulating concentrations of glucose, insulin, insulin-like growth factor I (IGF I) and cholesterol; and higher concentrations of fatty acids and urea compared with cows in positive energy balance. These are subsequently associated with an increased risk of metabolic diseases (that largely occur within the first month of lactation), reduced immune function and a reduction in subsequent fertility [44].

Environmental and animal management factors should be considered the following in order to reduce the incidence of RBC syndrome. Calving or breeding season, estrus detection, hygiene at artificial insemination or parturition, stress condition during heat [45].

Abnormalities Related to Semen Quality as Causes of Repeat Breeding: Genetic Defect and Aging of Spermatozoa: All cells undergo senescence. Spermatozoa, however, are especially susceptible to aging. Their highly concentrated nucleic DNA and reduced cytoplasm may result in DNA damage that is more likely to accumulate without repair. Furthermore, their high metabolic activity results in substantial exposure to oxidative stress, leading to extensive cellular damage over time. Negative consequence of the functional decline of aging sperm has effect on different aspects of reproduction, such as sperm motility, fertilization potential or embryonic survival [46]. Morphological Abnormalities of Spermatozoa: Any morphological deviation from the normal structure of

spermatozoon has been considered abnormal. The population of sperm reaching the site of fertilization (oviductal ampullary-isthmus junction) is enriched in both viability and normal morphology over that inseminated. Although morphologically abnormal sperm have been associated with sub-fertility and sterility for many years, it is now known that sperm with classically misshapen heads do not traverse the barriers of the female reproductive tract or participate in fertilization based upon accessory sperm data from ova and embryos [47].

The zona pellucida of the ovum, however, may be the most formidable barrier to participation in fertilization of morphologically abnormal, viable sperm. Further, sperm with abnormal acrosomes have been reported to be impaired in their ability to attach to the ovum in vitro and fail to penetrate the zona pellucida [48].

Approaches to Diagnostic Measures: First of all, a complete clinical history should be obtained at herd and individual level. Age, parity, milk yield, previous diseases, reproductive indexes, estrous cycle characteristics, insemination schedule, bulls, estrus detection, hormones, food and farm hygiene should be registered. Now, anatomy, morphology and function of cows should be inspected. The reproductive status of animals must be according to their production cycle. Sexual behavior must be evaluated to detect disorders, as muscle or claw lameness. Similarly, it is necessary to examine the behavior of bull and bull-cow interactions when natural breeding is carried out. Vulva, vagina, cervix, uterus, fallopian tubes and ovaries must be evaluated to diagnoses reproductive defects. In general there are six major diagnostic approaches as follows; external inspection and vaginal evaluation, rectal palpation in cow, ultrasonography, hormonal function tests, oviductal patency, endometrial cytology and uterine bacterial culture [49].

External Inspection and Vaginal Evaluation: External inspection can identify congenital or acquired anatomical defects as pneumovagina, vulvar defects, tumors or injuries. The anatomy of the area, secretions around vulva or tail and vulvar and vaginal coloration should be evaluated. In vaginal palpation, vulvar and vestibular functionality are evaluated though the pressure of these structures around the clinician's hand. It also assesses the presence of adhesions, abnormal structures and cervical defects. The vaginal contents should be inspected to detect urine (if urovagina), pus (if endometritis, vaginitis), blood (post-ovulation or some diseases) or clear and clean mucus (associated with heat) [50].

Rectal Palpation in Cow: Rectal palpation is a widely used diagnostic method in cattle with high accuracy, easy to be implemented and at low cost in comparison with other sophisticated techniques. Plastic gloves are lubricated and then feces are withdrawn. Air should not be present into the rectum to get a more relaxed mucosa and easily manipulate the structures beneath. The cervix is presented as a solid structure, tubular, fibrous, with 3-4 folds projected inside and localized on pelvis floor in normal non-pregnant cows. Cranially the uterus can be palpated. At heat, uterus is turgid, erect and coiled. However, it is soft and flaccid during luteal phase and palpation is a bit more difficult; it is a consequence of the progesterone action, released from CL. Palpation helps to diagnose anomalies such as uterine infections [51].

Ultrasonography (US): Transrectal ultrasound diagnosis has improved our ability to assess the reproductive organs in cattle and to follow the dynamic interactions between ovarian follicular cohorts. Even 2-3 mm follicles can be seen, quantified and sequentially monitored, allowing the development of superovulation regimens, an essential practice for the embryo transfer industry. US practical uses include routine assessment of follicular and luteal development and differential diagnosis of cystic ovaries, ovarian abscesses and tumors, which can be considered factors associated with RBC syndrome. US helps to evaluate the uterus by detecting changes in shape and echotexture related with circulating hormone concentrations during the estrous cycle and thereby detecting hormonal imbalances. It is also useful for detecting pathological conditions such as metritis, pyometra, maceration or mummification and it is an important tool for diagnosing ovarian cystic disease [52].

Hormonal Function Tests: Progesterone can be considered as a sensor of the reproductive capacity, both for its information about the estrous cycle and for its easy determination. Progesterone assay is an objective and accurate test to evaluate the ovarian function and to diagnose certain diseases that otherwise could not be correctly determined, such as delayed ovulation, persistent luteal activity, ovarian cysts or supra basal progesterone levels [53].

Oviductal Patency: The determination of oviductal permeability is interesting, although it is difficult to carry out. It is an injection of 500 ml of sterile solution containing 30 gram of starch. It is intra-peritoneally injected and starch reaches the oviduct and descends to the cervical mucus if the fallopian tubes are permeable. It takes about 12 hours to arrive at the cervical mucus, where it will remain between 2 and 4 days. A sample of mucus is collected, stained with lugol and observed under the microscope [54].

Endometrial Cytology and Uterine Bacterial Culture: Infectious diseases could provoke vulvitis, vaginitis, cervicitis or endometritis and it is interesting to diagnose these disorders. Usually, uterine inflammatory disorders begin with bacterial contamination into the uterine lumen and continue with adhesion of pathogens to the mucosa, colonization or penetration of the epithelium and/or release of endotoxins. In cattle, especially due to the cervical anatomy, samples can be taken using a catheter connected to a syringe containing 30-60 ml of sterile saline. It is deposited into the uterus and then it is removed and cultured. Cytological examination of the reproductive tract is often used to evaluate possible reproductive lesions in domestic animals. Endometrial cytological examination in mares and cows are accepted diagnostic techniques. Neutrophils constitute the first defensive barrier against invading pathogenic organisms postpartum, resulting in an increase in the polymorphonuclear neutrophils population within the uterine lumen [55].

Remedial Measures to Solve the Problem of Repeat Breeding: To reduce the negative effects of repeat breeding on the farm profitability, an effective therapy must be established after a proper diagnosis. Nutritional supplements have been used to restore certain imbalances at herd level. Diets containing higher concentration of inorganic iodine from 8-12 days before estrus improve the stimulation of the pituitary gland, reducing at the same time the RBC rate. Herds with problems of repeated estrus were supplemented with copper and magnesium, improving fertility problems. Deficiencies of these minerals have been associated with infertility, anemia or immune suppression. The assisted reproductive techniques, such as in vitro production or embryo transfer, intraperitoneal insemination, have provided new therapeutic options for resolving this syndrome. Abnormal implantation and transport of gametes are associated with endometrial defects, resulting in RBC syndrome [56].

Prophylactic practices have been used, as the uterine administration of antiseptic solutions (lugol) 24 h. after mating/AI, although fertility results are poor. Studies on bacteriology and histology of the uterus concluded that the non-specific genital infection is one of the main causes of RBC and it is suggested that antimicrobial treatments (chloramphenicol, gentamicin, enrofloxacin, tetracycline, or nitrofurantine) could improve the reproductive indexes [57].

It is also essential to improve all aspects related to heat detection, since it has been demonstrated that estrus detection mistakes involve very significant losses in reproduction and production cattle. Treatments are being used recently for fixed-timed artificial insemination, without heat detection. These protocols allow the treatment of cows with silent heats or ovulation problems by administration of PGF_2alpha and GnRH to schedule the insemination time [58].

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