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An Overview on Reproductive Disorders in Indigenous Female Equids

S.K. Ravi[1*], P.S. Yadav[2], R.K. Singh[1], Thirumala Rao Talluri[1], Y. Pal[3], A. Arangasamy[4], J Singh[1], R.C. Sharma[1] and Susavi Kumari[5]

[1]*National Research Centre on Equines, Bikaner, INDIA*
[2]*Central Institute for Research on Buffaloes, Hisar, INDIA*
[3]*National Research Centre on Equines, Bikaner, INDIA*
[4]*Scientist, National Institute of Animal Nutrition and Physiology, Bangalore, INDIA*
[5]*National Dairy Research Institute, Karnal, INDIA*

**Corresponding Author: SK Ravi; Email: skravivet@gmail.com*

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ABSTRACT

Reproductive disorders causing reproductive failure in equids put great challenge in achieving the goal of successful breeding every year and subsequent birth of live foal. Economic losses due to reproductive disorders are caused in terms of reduced fertility, longer calving interval, low life time production and increased expenses on medication as well as breeding. In India, major reproductive problems reported in mares are infertility, abortions, reproductive tract infections and dystocia. Other less common reproductive problems are placental retention, placentitis, vaginitis, still birth and poor perineal conformation.

Keywords: Donkey, Disorder, Equid, Mare, Reproductive problem

Equine population in India mainly comprise of donkeys, mules, ponies and horses. Horse population includes both Indigenous and Thoroughbreds. Exotic. Breeding mares for foal and mule production is main purpose of rearing in addition to their special significance in transport, riding, military, recreation as well as sports. Occurrence of reproductive disorders cause great economic losses in terms of reduced fertility, low life time production, longer calving interval and increased expenses on medication (Samad *et al.,* 1987). The major reproductive problems reported from 14 states of India were infertility, reproductive tract infections (endometritis, metritis and pyometra), abortions and dystocia in equid population (Singh *et al.,* 2010). Studies conducted on about 1500 nondescript mares in India revealed that more than 15 per cent mares remain barren every year and about 5 per cent remain barren for years together (Singh *et al*., 2005; Chandra, 2006; Singh *et al*., 2008a,b). Much of the information on reproductive characters in India is available with exotic breeds of mares (Singhvi, 1992; Bhuvankumar, 2007; Sharma *et al*., 2010a and Sharma *et al*., 2010b). Thoroughbred mares bred under Indian subtropical climatic were studied

for their reproductive performance and a comparatively lower fertility rate was recorded than from temperate region (Bhuvankumar, 2007; Sharma *et al.*, 2010a and Sharma *et al.*, 2010b, Sharma *et al.*, 2010a) indicating climatic effect on postpartum reproductive and ovarian activity (Sharma *et al.*, 2010b). Breed differences and individual variations in reproductive parameters have been reported to exist in mares.

(Gibbon, 1966). Further, reproductive disorders in the livestock could only be minimized when sufficient information regarding reproductive status of the animals is available (Dhanani *et al.*, 1987). These necessitate revealing literature available on reproductive health issues of equines in India. In present article, reproductive disorders among female equids population in India have been reviewed. This may help to understand current status of reproductive disorders in equines and the research gap in Indian context.

BREEDING SEASON AND REPRODUCTIVE CYCLE IN EQUINES

Equids are seasonally polyestrous species. Under Indian subtropical conditions, breeding season for non-descript ponies is mid February to mid November (Pal and Gupta, 2005) which is also true for descript mares as per our observations under farm conditions. During the breeding season, cycle length in mares is about 22 days with 5–7 days of estrus. The average length of cycle reported was 25.6 (range 25-27 days) and 25.06 (range 23-27 days) in indigenous donkeys and ponies, respectively, whereas the average duration of estrus in both species was 5 days ranging 3-8 days (Pal and Gupta, 2005). Marwari mares maintained at NRCE Bikaner farm, having a mean of 19.16 ± 0.71 (range 13-29) days estrous cycle and an average duration of estrus was observed as 6.14 ± 0.21 days with the range of 3-11 days, respectively (Arangasamy *et al*., 2008). The length of the estrous cycle, specifically diestrus period in the donkey is on average 18 to 19 days which is approximately 2 to 3 days longer than diestrus in mares which is approximately 14 to 15 days. Therefore, the estrous period of the mare (about 19 to 22 days) is shorter than total estrous period of the jenny which is about 25 to 26 days (Ginther *et al*., 1987). Gestation period of jennies is 12 months, which is about a month longer than mares i.e. 328 days, (Arangasamy *et al*., 2008) and this difference is about 36 to 37 days longer to be exact (Fielding, 1987). Another major difference with estrous cycles of jennies and mares is the seasonality. Unlike mares the availability of feed or nutrients has a stronger implication over the estrous cycle in donkeys than the photoperiod alone (Lemma *et al.*, 2006). One of the most challenging parts of breeding season is getting the breedable equids to conceive.

INFERTILITY

The causes of infertility may be infectious, traumatic, hormonal, neoplastic and congenital abnormalities (McKinnon and Voss, 1993). Infertility in equine can be described under three major categories: (i) lack of estrus cyclicity, (ii) cyclic but

fail to conceive and (iii) that conceives but suffers from early embryonic mortality (Purohit, 1997).

Anoestrus: Most of the times occurrence of anoestrus in equids is physiological rather than pathological. Gestation becomes main physiological reason behind non seasonal anoestrus. Other physiological causes of failure to cycle in equids include seasonal winter anoestrus, animal undergoing transition period, prolonged diestrus and behavioral anestrus. Most non-pregnant mares pass into a state of deep anoestrus during winter when day length decreases and in spring ovarian activity is stimulated largely by increasing daylight length. Failure to develop ovulatory follicles in the breeding mares is a common problem during the early or late breeding season and the etiology of the condition is multi-factorial but day length, nutrition, management are the main factors. Non-seasonal anoestrus may be caused due to lack of follicular development, persistence of corpus luteum, or it may be silent heats despite the cycling ovary (Bruyas, 2003). The age of the animal and lack of fat reserves are causes of follicular growth arrest. Endocrinopathies and ovarian tumors (granulosa cell tumors are most common) also result in arrest of follicular growth. Persistence of corpus luteum is major pathological reason behind anoestrus. Persistence of corpus luteum may occur following embryonic resorption after day 16 of gestation. Silent heats are often associated with maiden mares, presence of newborn foals, inhibition due to manipulation at hand mating, or defective socialization of the female to its surroundings. Incidence of anoestrus in 3.57% of thoroughbred mares was reported under subtropics (Purohit *et al*., 1999). A long period of anoestrus may be seen after an abortion occurring during the period of endometrial cup secretion (Bruyas, 2003). The first estrus (foal heat) usually occurs 5 to 11 days after foaling. In some cases, a large proportion of mares fail to show oestrus behaviour during the first 20 days after foaling. This postpartum acyclia is observed only in mares that foal early in the year. Congenital abnormalities are manifested clinically with persistent anestrus, non cyclic estrus, conception failure and gynaecologically reveal small or non functional ovaries on examination.

Repeat breeding: Repeat breeder animal is usually defined as sub-fertile animal mated three or more times during the proper period and does not become pregnant and continually return to estrus in the absence of any obvious pathological disorder in the genital tract (Parkinson, 2009) and has normal estrous cycles (Dochi *et al*., 2008). Causes of this type of sub-fertility can be divided into two major categories; fertilization failure and early embryonic death.

Fertilization failure due to inability of growing follicle result into ovulatory follicle is physiologically common in equids undergoing transition during early or late breeding season when the cyclicity is abnormal. Pal and Gupta (2005) in their study on folliculogenesis reported 10% irregular cycles with an average follicle size of 20 mm in indigenous donkeys and pony mares during transition period. Repeat breeding due to physiologic ovulation failure was also reported in post-partum mares and Jennies (Dadarwal *et al*., 2004). Insemination with poor quality

semen, improper time and site of insemination could be others reason causing fertilization failure. Repeat breeding could be due to fertilization failure but more likely due to early embryonic mortality. Age of the animal influence on fertility with highest embryonic loss rates (20-30% or more) have been detected in mares more than 18 years of age (Carnevale and Ginther, 1992). Bhuvankumar (2007) also reported decline in conception percentage as the age advances in mares. Breeding, foaling, and manipulation of the reproductive tract during examination are procedures which normally challenge the defenses of the uterus against infection. Bacterial infections and sexually transmitted diseases are the most important factors responsible for infertility and reproduction losses. *Klebsiella pneumoniae, Taylorella equigenitalis* and *Pseudomonas aeruginosa* are the important causal agents of sexually transmitted diseases. Study conducted to determine the type and antibiogram of different bacteria from the genital tract of mares with the history of repeat breeding found *Escherichia coli, Staphylococcus aureus* and *Staphylococcus proteus*, the main pathogens responsible for repeat breeding (Arora *et al.*, 1998). From repeat breeding mares, as well as from mares with clinical symptoms of endometritis, E. coli was the most frequently isolated species (Albihn *et al.*, 2003).

Early pregnancy losses: Early embryonic mortality in mares is defined as the loss of the embryo between fertilization and day 40 of gestation. Early embryonic deaths accounts for 8 to 15% losses (Roberts, 1980) in equines. Early pregnancy failure in ponies are high under artificial condition compared to natural (Bains and Sharma, 2004). The causes of early embryonic losses include both intrinsic (endometrial disease, progesterone deficiency, maternal age, lactation or foal heat breeding) and extrinsic factors (stress, nutrition, climate, breeding management and techniques, and sire factors). Bains and Sharma (2004) indicated either heredity or management or both as cause for high rate of early pregnancy failure. The overall detected pregnancy losses reported in mares at ages 3–7 years were lower compared to those at age e”18 years (14.78% vs. 46.43%, respectively). Endometritis provides a hostile uterine environment which is toxic to the embryo or causes enough irritation of the endometrium to cause the release of prostaglandin. Endometritis results in the loss of the embryo in three possible ways. Firstly, the increased number of inflammatory cells in the uterus, initiated by infection causing destruction of the embryo. Secondly, the organism causing the infection may have a direct effect on the embryo. Thirdly, uterine irritation due to infection may cause the mare to return to heat through the release of prostaglandin. Decreased progesterone in early pregnancy may be due to endometritis, failure of maternal recognition of pregnancy or primary insufficiency of the corpus luteum. Stress has been shown to decrease progesterone levels in the mare, which in turn lead to increased embryonic losses. Poor mare nutrition and body condition influence the rate of embryonic loss.

ABORTION

Abortion is another common problem in equines. Abortions have been reported due to multifactorial etiology including hormonal, genetic, viral, fungal, rickettsial and

bacterial origin (Garg and Manchanda, 1986). Infectious causes are always responsible for more than 50% abortions (Varshney *et al.,* 1994) and among the infectious causes, bacteria are invariably reported either as primary cause or as secondary invader (Garg and Manchanda, 1986).

Bacterial abortions: *Enterobater agglomerans* (*Pantoea agglomerans*) has been reported to cause acute placentitis leading to occlusion of blood supply to the fetus, eventually fetal death and abortion during 7-8 months of pregnancy (Hong *et al.*, 1993). Multiple drug-resistant (MDR) salmonellae are of common occurrence in equids in India and are important bacterial agent responsible for abortions and reproductive problems in equines. The significant association of some cases of aborted foetus was revealed with the presence of S. *equisimilis,* S. *zooepidemicus* and S. *equi* (Malik *et al.,* 2002). Infections with *Salmonella enterica* subspecies *enterica* serovars causing abortions in mares and may also lead to temporary subfertility or infertility (Singh *et al*., 2005, 2007a, b). This causes fetal death particularly in last trimester of gestation leading to abortion. S. *zooepidemicus* as cause of abortion in mares have also been reported by Puran Chand *et al*. (2001). Brucellosis was diagnosed in 11 of the 44 (22.7%) mares from stud farms with histories of abortion (Kulshrestha *et al.,* 1977). Klabsiella pneumoniae was isolated from 12 of 20 (60%) aborted fetuses and from 15 of 40 (37.5%) cervical swabs from infertile mares (Rao *et al*., 1982). *Rhodococcus equi* has also been associated with foal mortality and reported as a sporadic cause of abortion. *R. equi* was found responsible for 84.6% foal deaths due to multiple pulmonary abscesses (Garg *et al.,* 1985). *Aeromonas hydrophila* has also been reported to cause infectious abortion in mares (Singh *et al*., 2008a, b).

Viral abortions: The (EHV-1) infection emerged in various parts of India during 1972-1976 caused infertility in equines. Abortion storm due to EHV-1 virus was also reported from an organized equine breeding farm (Uppal *et al.,* 1991). In a national assessment of EHV-1 infection in India, from 1989 to 1997, distribution of positive seroreactor was 18.2% (15/82) in aborted mares, 11.6% (197/1695) in apparently healthy horses and 2% (1/50) in donkeys (Singh *et al*., 1998). Abortions in mares due to virus were also recorded during 1996 and 1997 (Uppal *et al.* 1991; Singh *et al.* 1998). EHV-4 is rare cause of abortion and it occurs suddenly. The aborted fetus is generally expelled live enclosed in fetal membrane and death may occur due to suffocation. Garg *et al.* (1977) isolated American type HH-1 equine rhinopneumonitis virus in material from an aborted equine fetus. Jain *et al.* (1978) reported equine rhinopneumonitis virus from samples of suspensions of liver, lung and spleen tissues from aborted fetuses. Equine Arteritis Virus (EAV) infection is known to affect reproduction in mares, causing abortion after the third month of pregnancy or the death of foals after birth.

Rickettsial abortions: Leptospirosis is considered responsible for abortions, still birth and perinatal death in equines. Seroprevalence of leptospirosis in Thoroughbred and indigenous horses from different parts of India were reported by Khurana *et*

al., (2003). Out of the 379 apparently healthy horses, 64 (16.89%) harboured antibodies against *Leptospira* sp. They further reported the mares that came into contact with aborted animals, 66.7% had positive titres indicative of leptospiral infection. Higher antibody titres in apparently healthy animals suggest either a subclinical form of the disease in these animals or previous infection. Region-wise seroprevalence of leptospiral antibodies showed that studs in southern and western part of the country were seropositive irrespective of the group.

Fungal abortions: Molds have also been reported to cause abortions as well as uterine and placental infections. Most common abortion causing agents among fungi were *Candida albicans, Aspergillus spp. and Mucor spp.* found in nine of 100 aborted horses in India. The presence of *Candida tropicalis* in 3, *Aspergillus fumigatus* in 3, *Candida albicans* in 2, and *Cryptococcus laurentii* in one of the cases (Monga *et al.*, 1983). In another study by Garg and Manchanda in 1986 in which 2000 pregnancies were followed in India, 175 abortions occurred and six were caused by fungi. The fungi involved were *Mucor* (three), *Aspergillus* (two), and *Microsporum* (one). A number of fungi, both saprophytic and endophyte, can produce mycotoxins in the class of chemicals called ergot or, more specifically, ergopeptine alkaloids responsible for abortions.

Genetic causes of abortion: Kaur and Sharma (1996) in their study on abortion frequency gestation, length and number of twins from eight stud farms in Punjab and Haryana reported an incidence of 40.25% of abortions in the eighth month of gestation. They found that young mares up to eight years of age accounted for 41.55% abortions. Twin abortions accounted for 25.98% of total abortions and were directly correlated to overall abortions. Purohit *et al*. (1999) reported 13.15% abortion in Thoroughbred stud mares, of which 40% of the total abortions being due to twinning. Incidence of multiple pregnancies was reported in 5.4% percent of late embryonic loses were higher in twin (21.98%) than single (8.64%) pregnancies (Sharma *et al.*, 2010a). There was a high degree of repeatability of double ovulations and twin pregnancies within mares and within family lines. The multiple ovulation rates were halved in foaling mares compared to barren and maiden mares (Ginther, 1982).

Endocrinological and other causes of abortion: Abortion may occur due to insufficient production of progesterone. In most of the animals, this hormone is produced primarily from corpus luteum of pregnancy. In horses, progesterone from corpus luteum of pregnancy produces enough progesterone to maintain pregnancy for only 40 to 50 days. Endometrial cups are formed in uterus by this time to which many follicles stimulate to grow and form accessory corpora lutea. Accessory corpora lutea produce supplementary progesterone up to fourth to fifth month of pregnancy. After this, placenta takes over the charge to produce progesterone to term. Torsion, or strangulation of the umbilical cord, is said to be the cause of fetal deaths and abortions in the later stages of pregnancy. Fescue toxicosis caused by fungal endophytes *Neotyphodium coenophialum* (formerly called *Acremonium*

coenophialum) can cause dystocia in mares and deaths of foals. Ergotism is another fungal clinical syndrome caused by the genera Claviceps. Claviceps can live on a variety of hays and pasture grasses and produce fruiting bodies on bluegrass and cereal rye. The Claviceps sclerotia (fruiting bodies) contain a large array of ergopeptine alkaloids similar to those seen in fescue toxicity. The ergopeptine alkaloids from fungi interfere with the normal rise of progestagens (mainly 5 alpha-pregnanes) and prolactin in the last 40 days of gestation. The manifestations in mares are thickened edematous placentas and agalactia. Nutritional deficiencies have not been associated with abortion in mares. In general, if mares are in good body condition of greater than 2 on a scale of 0 to 5, where 5 represent very fat), they will carry a foal. Mares that are too thin, however, will not cycle or conceive. In spite of common beliefs, injury seldom causes abortion.

REPRODUCTIVE TRACT INFECTIONS

Several bacterial species which enter the uterus at foaling, breeding, during routine gynaecological examinations and through vulvar defect are responsible for reproductive tract infections. Manchanda *et al.* (1983) collected uterine swabs of 328 infertile mares aged 10 to15 years out which 297 had bacteria in the swab. Singh (2009) examined vaginal swabs of 54 infertile and 12 healthy mares in which *Pseudomonas aeruginosa* (18.5%), *Aeromonas hydrophila* (5.6%), *Edwardsiella tarda* (7.4%), *Enterobacter agglomerans* (27.8%), *Streptococcus zooepidemicus* (11.1%), and majority (18/19) of *Enterococcus cecorum* (33.3%) were isolated from infertile mares only. Isolation of these bacteria only from infertile mares indicated that these bacteria might cause reproductive tract infection. Infertility in 77.6% of the mares was found associated either with bacterial or fungal agents as reported from various organized farms in 58 mares (Virmani *et al.,* 2007). Of 27 mares with chronic infertility problems, *Alternaria* spp., *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *Mortierella wolfi,* and *Mucor* spp. were isolated from cervical, vaginal, or clitoral fossa swabs (Verma and Gupta, 1983). Reproductive tract infections of mares are important because they may turn fertile mares to barren (Singh, 2003).

Endometritis: Endometritis is major concern in reproductive tract infections. Endometritis could be due to infections and can be sexually transmitted like contagious equine metritis (CEM) caused by *Taylorella equigenitalis*. This can further be caused by chronic degenerative (endometriosis) or mating induced commonly called persistent mating induced endometritis. Aging and multiple foaling may result in anatomical defects which subsequently predispose mares to endometritis (Caslick, 1937). Kalirajan and Rajasundram (2008a) reported positive correlation of mare' age and caslick index. They also reported significantly lower incidence of infection and caslick index between age group of 6-8 than 10-12 and above 12 years. Therapeutic management of endometritis in a Marwari mare has been reported by (Arangasamy *et al.,* 2009a). Kalirajan and Rajasundram (2008b) described effective schedules to treat endometritis with gentamicin alone or in separate combination with PGF_2-á and oxytocin.

Metritis and Pyometra: A variety of organisms can be involved with metritis and pyometra and revealed significant association with the presence of S. *equisimilis*, S. *zooepidemicus* and S. *equi* (Malik *et al.*, 2002). There are several possible etiologies for pyometra. Pyometra was found associated with a wide variety of bacteria, particularly *Escherichia coli*, *Proteus* spp. and *Citrobacter spp*. (Manchanda *et al.* (1983). In some cases a negative culture may be obtained and cervical adhesions or malfunction with failure to drain uterine contents are often implicated. There is usually no sign of systemic illness and damage to the uterus is most severe long standing cases or those with a closed cervix. In less severe cases atrophy and fibrosis of endometrium is found and if it will clear up, chances of reoccurrence is there.

DYSTOCIA

Occurrence of dystocia in mares is comparatively less common but due foals having long neck and legs may assume many postures which could cause problem during the birth process. Dystocia were reported in 12 (4.88%) out of 246 deliveries in Thoroughbred mares (Narale *et al*., 2007). The difficulties in delivery of foals were reported mainly due to still birth, death of fetus in utero, deviation of neck, hyper flexion of knee joints/hock joints, feto-pelvic disproportion etc. Thick allanto-chorionic membranes resulted in delayed rupture of the membrane in four cases accompanied by dry vaginal passage. Saravanan *et al.* (1998) reported 22.5% incidence of dystocia in thoroughbred mares, out of which 78.76% were due to postural defect of foals at parturition. Sharma and Dhaliwal (2010) reported 3.14% incidence of dystocia in a study on 734 mares from Thoroughbred stud farms in Punjab and Haryana. A case of dystocia in Indian wild Ass due to abnormal presentation and position was reported by Sabapara *et al*. (2001). Dadarwal *et al.* (2008) presented a case of dystocia in a mare related with the congenitally deformed foal. Nakashi *et al.* (2008) reported dystocia due to right lateral deviation of neck

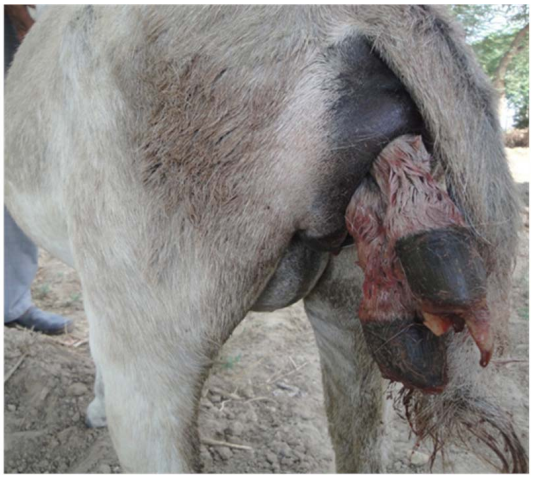

Fig. 1: An indigenous donkey with dystocia visited to NRCE, Bikaner clinics

and another due to ventrally deviated head with knee flexion. Dystocia due to oblique ventro-transverse presentation (Nakashi *et al.*, 2009) and due to anterior longitudinal presentation with dorso-sacral position and shoulder flexion of right forelimb (Bhoi *et al*., 2010) have also been reported in mares.

OTHER REPRODUCTIVE PROBLEMS

Other less common reproductive disorders in equines are placental retention, placentitis, vaginitis and pneumovagina. Fetal membranes are usually expelled within 3 to 4 hours in mares that have normal, uncomplicated deliveries. If membranes are not delivered within 6 to 8 hours, most clinicians consider them to be retained placenta (Card, 2003). Equine placentitis, and resultant preterm labor, are important sources of fetal and neonatal loss. The primary cause of equine placentitis is infection of the placenta with *Streptococcus equi* subspecies *zooepidemicus*, which ascends through the caudal reproductive tract (Macpherson, 2005). The cases of placental retention, vaginitis and pneumovagina were reported 4.61, 0.71 and 4.28% respectively in a study of reproductive performance and disorders in thoroughbred stud mares (Purohit *et al*., 1999). However, they suggested that the low incidence of reproductive disorders could be because the thoroughbred horses being valuable and most cared species. Anatomical defects such as poor perineal conformation resulting in pneumovagina pulling air into vagina along with bacteria and urine pooling (urovagina) was reported 31.1% of infectious causes of the infertility (Virmani *et al.*, 2007). Weak reproductive structures may caused urine pooling, a condition in which mares do not void urine completely, particularly during estrus. The retained fluid can cause inflammation, and prevent conception.

A case of the pre-pubic tendon rupture with complete tearing of the ventral abdominal wall and separation of the gravid uterus from the cervix in a pregnant mare is also reported by Brar *et al.* (2007). Post coital laceration of cranial vagina due to covering with stallion and development of vaginitis was reported in a Thoroughbred broodmare (Dadarwal *et al.*, 2002*).* Cervical tear may also be associated to previous foaling injury due to dystocia or abortion in late gestation. Though unreported, problems of cervical fibrosis, cervical adhesion to vaginal fornix, vaginal tear. Cervical tear may subsequently lead to adherence with vaginal fornix or fibrosis due to scarring of the damaged tissues. Vaginal tear is breeding accident observed after natural mating and may be due to vaginal perforation.

Fig. 2: A still birth in Marwari mar occurred at NRCE, Bikaner sub campus

Fig. 3: A mare with retained fetal membrane

Fig. 4: A mare with retained fetal membrane and vaginal tear

Fig. 5: A mare with vaginitis

Fig. 6: A mare with poor perineal conformation

FUTURE RESEARCH AREAS

Further investigations are needed on all the aspects of reproductive health problems in equines to generate sufficient information in Indian context especially from donkey's reproduction. Predicting time of ovulation and suitable single time breeding in equines need attention. Whether genetic reasons underlie the sub fertility can be explored. Still there is lack of an appropriate treatment that can resolve completely the problem of endometritis and uterine infections is warranted. Attempts should be made to reduce early embryonic losses and to enhance overall reproductive efficiency. Development of sensor based estrus and ovulation detection devices can help to improve the reproductive performance in these unique animals having longer estrus period.

This is concluded that limited information is available on reproductive health issues in equines in Indian context. This may be due to either of insufficient research done or lack of publications or both. Though mare is not enough studied, much of the information on reproductive disorders of equids in India is available mainly on mares compared to Jennies and less attention is paid to donkeys. Reproductive failure in female equids is mainly due to infertility, abortions, reproductive tract infections and dystocia in addition to other reproductive problems like placental retention, vaginitis, still birth and poor perineal conformation etc. Successful breeding during breeding season is most challenging especially in mares because of cost involved in breeding and rearing. Genital infections usually from bacteria are major reason of reproductive failure by causing endometritis and uterine tract infection.

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