Hereditary and Congenital Causes of Infertility in Buffalo (*Bubalus Bubalis*) Bulls

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Abstract

The artificial insemination (AI) technique plays an important role in improvement of conception rate, prevention of sexually transmitted diseases and carryout of genetic material to next generation. The breeding soundness evaluation (BSE) plays an important step in selection of male buffalo for the said above purpose. This evaluation is an effective way, inexpensive and easy method for selection of breeding buffalo bull. In buffalo breeding management programme, the seasonal variation, nutrition, congenital defect, hormonal changes and hereditary plays a critical role in determining the reproductive efficiency in buffalo bull. The information regarding the reproductive efficiency of buffalo bull is meager for breeding soundness evaluation. The genetic defect has spread to next generation from the genetic defective sire and it will cause congenital defect in offspring. To avoid this problem, cytogenetic selection is very useful. So, a male buffalo calf being purchased for breeding purpose must be evaluated for breeding soundness examination. The breeding soundness evaluator should take care of genetic and congenital condition of male animal used for breeding programme.

1. Introduction

The buffaloes are in the order of *Artiodactyla*, the cloven-hooved mammals, genus *Bubalus* and species *bubalis*. Two main species of buffalo are found in the world-the Asiatic (water) buffalo (*Bubalus bubalis*) and the African buffalo (*Syncerus caffer*). The two buffalo types are have different habitat and chromosome numbers. There are about 170 million buffaloes in the world (Perera et al., 2005). Out of this 97% are water buffaloes and mainly found in the Asian region. Riverine buffaloes are characterized by black color and have long curled horns and the swamp buffaloes are dark grey but may also be black, black and white, or even all white, have long, gently curved horns. Riverine buffaloes (70% of the total world population) are reared in high numbers in South Asia, especially in India and Pakistan. The name 'swamp' has probably arisen from their preference for wallowing in stagnant water pools and mud holes (Abeygunawardena and Abeygunawardena, 1998). Swamp buffaloes are found in South-east Asia and Southern China, mainly Thailand, the Philippines, Indonesia, Vietnam, Burma (Myanmar), Laos, Sri Lanka, Kampuchea and Malaysia (Chantalakhana and Falvey, 1999). Riverine buffaloes are predominantly used for milk production and they are also used for meat, fuel and fertilizer production, as well as for draught power, whereas Swamp buffaloes are traditionally kept as draught animals and are also (to a lesser recognition) used for meat production. The river-type buffalo has a diploid number of chromosomes 50 as compared to 48 for the swamp-type buffaloes. The Murrah has two extra acrocentric chromosomes, which are presumably translocated onto the short arms of the number 1 autosome of the swamp buffalo. Differential staining revealed that Egyptian water buffaloes, with a diploid number of 50, are closely related to Murrah buffalo (Cribiu and Obeidah, 1978). Hybridization between Murrah and swamp buffaloes is possible and the hybrids are fertile. Improvement of buffalo reproduction helps the production to enhance significantly the economy and living standards of many rural communities throughout the world. The male contributes 50% of germ-plasm to the fetus and bull is half of the herd. The common defect affects the male fertility are congenital defect in male reproductive tract, hormonal imbalance between different glands, infectious diseases of reproductive system or any other system, hereditary defect, imbalanced nutrition, psychological defect and abnormal climatic condition. Generally the recommended bull: cow sex ratio for this species is 1:30 and is reported for buffaloes from many countries and this rate is 1:50 by Vale et al. (1991) for natural service and artificial insemination (AI) helps the utilization of male in better way to improve the reproductive fertility. In the male animal, fertility can be defined as the ability of a bull to produce semen that will result in a successful pregnancy (Vale, 2009). The purpose of this paper is to describe the different type of disturbance, which are affecting the reproductive performance of buffalo bull. The review describes about congenital, hormonal, infectious, hereditary, and environmental causes of infertility.

2. Hereditary Causes of Infertility

Reproductive problems in male animals such as late maturity, infertility and sterility are widespread in buffaloes (Vale, 2009). Various chromosomal aberrations associated with infertility and reduced fertility has been documented in river buffaloes. The hereditary causes of infertility are varied and affect the reproduction and fertility in farm animals. Several studies indicated that the chromosomal abnormalities are one of the causes of lower fertility in cattle and buffalo population (Iannuzzi et al., 2001, 2004; Maikinen et al., 2001; Ruvinsky and Spicer, 1999; Giovanni et al., 2006; Schepper et al., 1982; Logue, 1978; Rao, 1980; Ahmad et al., 2004; Di Meo et al., 2008; Ansari et al., 1993). Infertility in certain bulls with apparently excellent semen was traced to intra-chromosomal aberration like translocation and inversion (Gustavsson, 1969). The chromosomal aberration especially the centric fusion has reach high frequencies in bovine population. The famous Robertsonian translocation (1; 29) found in more than 40 breeds of cattle (Popescu and Pech, 1991) with variable frequencies. In addition to the commonly detected 1/29 centric fusion in cattle, various other types of chromosomal abnormalities including reciprocal translocation (Schepper et al., 1982), X- autosome translocation (Basrur et al., 2001), inversion (Popescu, 1990), insertion (Moraes et al., 1987), tandem fusion (Hansen, 1969), balanced autosomal reciprocal translocation (Ansari et al., 1993) and XXY Karyotype with an unusual X; X translocation (Chauhan et al., 2009) were reported. The heritability of various phenotypic and reproductive traits is hardly of 5% or less which is further compromised by environmental influence (Berglund and Philipson, 2001). So it has been reported that during breeding soundness examination of buffalo, should give special attention towards the hereditary diseases, which can cause many morpho-functional disturbance related to the genital system such as gonadal hypoplasia, epididymal dysfunctions, arrested development of mesonephric ducts, absence or weak libido and it may be due to inbreeding (Vale, 2009). Various chromosomal anomalies associated with infertility and reduced fertility have been documented in cattle (Ruvinsky and Spicer, 1999; Popescu, 1990; Iannuzzi et al., 2001; Giovanni et al., 2006; Schepper et al., 1982; Logue, 1978; Rao, 1980; Ahmad et al., 2004), but only a few cases has been reported in river buffaloes. Most of these buffaloes has showed chromosomal anomalies involving autosomes, such as translocation (Vijh et al., 1994), chromosomal polymorphism (Patel et al., 1997; Patel and Khoda, 1998), inversions (Balakrishnan et al., 1985), fragile sites (Sanghamitra et al., 2004) and secondary constrictions (Balakrishnan and Yadav, 1984; Patel, 1999) or sex chromosome aneuploidy, such as XO syndrome (Yadav et al., 1990; Prakash et al., 1992; Iannuzzi et al., 2000), XXX syndrome (Balakrishnan and Yadav, 1984; Prakash et al., 1994; Iannuzzi et al., 2004) and XX/XY chimerism (Balakrishnan et al., 1981; Iannuzzi et al., 2005). Sex reversal syndrome (Iannuzzi et al., 2004) and gonadal dysgenesis (Iannuzzi et al., 2001) were also reported in this specie. A male river buffalo calf having XXY-syndrome (Klinefelter's syndrome) with an XX translocation with diploid chromosome number (2n=50) was reported by Patel et al. (2006). The sound neuro-musculo-skeletal system and hoof system is important for normal function of animal as well as the reproductive system and is genetically transmittable. So any defect like sickle hocks, post legs and bent or knock knees may develop soreness. The result is the inability to travel and mount for mating, which leads to affect the libido and semen quality and ultimately affect the fertility of the bull (Lagerlöf, 1936; Roberts, 1971). Variation of normal scrotal confirmation such as elongated testes, rounded testes, rotated testes, distinctively cleaved testes and some abnormal scrotal confirmation such as testes held too close, unilateral hypoplasia, scrotal hernia and incomplete descent are genetically inheritable and causes infertility to sterility depending on the condition.

3. Congenital Causes of Infertility

Congenital causes of infertility are due to congenital defect at the time of birth, which may be caused by genetic factors or other factors (e.g. high temperature, hormonal imbalance or nutritional deficiency at the time of intra uterine life, etc.). Infertility due to congenital anatomical defects of genital organs has been reported in bulls by Blom and Christensen (1972). There are many cases of congenital defect has been reported in male bovine and buffalo and various defect with different parts of reproductive tract due to arrest development of mesonephric ducts in the male animals (Vale et al., 2002). They are unilateral misplaced testicles, paraphimosis, cryptorchidism, bilateral spermiostasis (Patel and Kaikini, 1972), fusion of ampulla (Chaudhuri et al., 1983), fusion of vesicular gland and unilateral segmental aplasia of wolffian duct (Kaikini and Patel, 1978), under development of seminal vesicle, absence of the testes (Chaudhuri et al., 1983), aplasia of gonads (Kaikini and Patil, 1978), testicular hypoplasia (Kodagali and

Bhavasar, 1973; Chaudhuri et al., 1983), bifid scrotum (Kohli and Rajwanshi, 1967; Rao 1980), pseudohermaphroditism (Singh et al., 1992), preputial diverticulum (Singh et al., 1986), right unilateral testicular neoplasm (Zanwar, 1974: cited in Rao, 1997), bilateral testicular aplasia (Arangasamy et al., 2005), testicular aplasia and hypoplasia (Ohashi et al., 1995), congenital umbilical hernia and cryptorchidism (Amle et al., 2004), torsion, displacement and bifid scrotum (Vale et al., 1988), left testis smaller than the right, with germinal cells absent, tesicular hypoplasia (Vale, 2009; Kaikini and Patil, 1978), diphallia (Landy et al., 1986), partial testicular hypoplasia (Ohashi et al., 1988). Rao et al. (1988) reported on the types of preputial sheath in 60 Murrah buffalo bulls. The preputial sheath was classified as pendulous, medium and tight sheath. The medium sheath was found to be most common variety (52.18%) followed by pendulous (30.43%) and tight sheath (17.39%). The congenital abnormality in buffalo bulls are categorized into following three groups:

- Congenital defect of testes
- Congenital defect of duct system
- Congenital defect of accessory sex glands

The reproductive organs and endocrine glands of buffalo bulls are smaller than those of cattle bulls. The average weight of testicles of Indian buffalo is reported about 78 g (Joshi et al., 1967). Segmental aplsia of mesonephric duct is a congenital hereditary condition most commonly seen in bulls. The body or tail or the entire epididymis may be missing (Blom and Christensen, 1960). In majority of the cases the condition is unilateral and the bulls are sterile. This can be detected by palpation. In bilateral cases the semen is watery with a few or no sperms.

3.1. Congenital defect of testes

The common defect testes are testicular aplasia, hypoplasia, absence of testicles, adhesion of tunica vaginalis, under developed testes, bifid scrotum, uni or bi lateral misplaced testes, elongated testes, rounded testes, rotated testes, distinctively cleaved testes, scrotal hernia and incomplete descent of testes. Bulls with abnormalities of testes should not be used for breeding purpose because most of these defects are heritable. In testicular hypoplasia, there is potential lacking of development of the spermatogenic epithelium and it has been reported in buffalo male animals. Testicular hypoplasia is a congenital and hereditary condition caused by single recessive autosomal gene with incomplete penetrance and increasing inbreeding (Vale, 2009). This is characterized by lack or marked reduction of spermatogenesis in one or both gonads during the fetal life. Testicular hypoplasia is suspected only at puberty or later because of reduced fertility or sterility. The gonadal hypoplasia is a congenital, mostly hereditary condition which can be unilateral or bilateral and total or partial and unilateral is more common than bilateral (Vale et al., 1988) with the hypoplastic testicle being considerably smaller than that the normally developed one and the affected testis to not sink so far down to the bottom of the scrotal pouch. The affected testes are smaller in size about ¼ to $^{2}/_{3}$ of the normal testes. The right testis (12.0 x 8.8 x 6.52 cm^3) is more affected than left testis (14.6 x 8.7 x 5.97 cm^3) (Kaikini and Patil, 1978). Maurya and Bhalla (1966) recorded testicular hypoplasia in buffalo bulls.

The seminiferous tubule are poorly developed and the rest of the reproductive organs are normal, because the interstitial/Leydig cells are normal and secretes sufficient amount of testosterone and the animal has showing the libido and mounting activity are normal. Reports about congenital defect in male buffalo animals are very less. Kaikini and Patil (1978) reported a case of aplasia of gonads in Berari bull. Chaudhuri et al. (1983) observed 4.06% cases of absence of testis out of 197 organs examined. Incidence of testicular hypoplasia in buffalo bulls has been reported 4-6% (Kodagali and Bhavsar, 1973; Chaudhuri et al., 1983). Arangasamy et al. (2005) reported that the right testes and the vas deference together were weighed 87.91 g and left testes and vas defense weighed about 61.01 g. The length and thickness of right and left epididymis were measured 35.2 x 2.66 cm^2 and 25.7 x 1.95 cm^2, respectively as compared with normal epididymis (right 14.1 x 0.86cm; left 12.95 x 0.71 cm). The right and left vas deference were measured 8.93 x 1.55 cm^2 and 8.72 x 1.02 cm^2, respectively. Histological structure of the hypoplastic testes and epididymis revealed that at the level of head, body and tail showed lumen lined with low columnar to cuboidal cells with no perceptible micro villi, micropinocytic invagination and eosinophilic bodies (Arangasamy et al., 2005). Pseudo stratification with moderately tall columnar cells was seen at place. The lumen was devoid of any spermatozoa except for the little fluid (Arangasamy et al., 2005) or there is presence of high number of immature spermatozoa (9.3%) and low sperm count (650 million ml^{-1}) (Arangasamy et al., 2005). There was thick layering of smooth muscle cells and connective tissue round the ducts. The interstitial connective tissue in between the ductules was thick and loosely arranged. The severe cases hypoplasia is diagnosed by scrotal and testicular measurements and karyotypic analysis may aid better diagnosis of the hypoplasia from blood of affected animal by assessment of chromosomal secondary constriction in leucocytic culture of blood. Ohashi et al. (1988) reported a case of bilateral partial hypoplasia in a Mediterranean buffalo bull, aged 3 years, presenting symmetrical testis 7.5 x 3.5 cm^2 and scrotal circumference lower than the normal average for Murrah buffaloes (Vale, 2009). The segmental aplasia of gonads of buffalo has been reported (Kaikini and Patil, 1978) and is bilateral with fibrous epididymis. The affected testis is a thin, hard, fibrous tissue mass bridging the caput to the corpus epididymis. It is measured the size in of 5.7 x 3.4 x 0.5 cm^3 to 4.7 x 3.9 x 1.1 cm^3.

3.2. Congenital defects of Wolffian duct system

Malformation of the male genital/Wolffian duct system include aplasia or hypoplasia of epididymis, epididymal cyst, and cyst of ampulla, epididymitis, spermiostasis, spermatocoel, affection of vas deference and ampulla, etc. It may be unilateral (fertile to infertile) or bilateral (sterile). The epididymis and ampulae segmental aplasia has been observed as the most common form of abnormality of Wolffian duct system (Vale et al., 2002). It is characterized by total or partial absence of one or both epididymis and in cattle the right epididymis is common. In an investigation of 39 male genitalia of mature Berari buffalo bulls, Patil and Kaikini (1972) found bilateral spermiostasis in three and fusion of ampulla near the urethral end in eight cases. Chaudhuri et al. (1983) found that fusion of ampulla was the most common abnormality in the buffalo bulls and they reported the abnormality in the buffalo bulls and they reported the abnormalities of ampulla and vas deferens in 30 and 32 cases, respectively out of 197 genital organs examined.

Spermiosatsis may be caused by blind, rudimentary mesonephric tubules, or ductli aberrantis. This condition is common in bucks and rams and less common in bulls. This is probably of genetic origin (Blom and Christensen, 1960). Kaikini and Patil (1978) reported unilateral as well as bilateral spermiotasis of cauda epididymis in Berrari buffalo bulls.

3.3. Congenital defect of accessory glands

The seminal vesicle is one of accessory gland most commonly affected in congenital defect. The congenital defect of these accessory glands is mainly due to developmental abnormalities of the Wolffian duct and may have some hereditary predisposition and it may takes place during intra uterine life (Luktuke and Namboothiripad, 1977). The common congenital defect of accessory glands in buffalo bulls are fusion of vesicular gland and unilateral segmental aplasia of seminal vesicles (Kaikini and Patil, 1978), under development of the seminal vesicle (Chaudhuri et al., 1983), unilateral and bilateral enlargement of the vas deferens called spermatocoel, fusion of ampullae (Maurya and Bhalla, 1966; Patil and Kaikini, 1972; Kaikini and Patil, 1978), under development of seminal vesicle or cystic vesicle (Luktuke and Namboothiripad, 1977), unilateral segmental constriction of right ampulla (Kaikini and Patil, 1978). The fused ampulla is associated with other genital malformation such as spermiostasis and pigmentation melanosis of the pelvic urethra (Kaikini and Patil, 1978).

3.4. Cryptorchidism

Cryptorchidism, or retention of testicles, is the commonest type of defective differentiation of the male genital system occurring in all domestic species and occasionally occurring in bovines. This condition is sporadic and is due to disordered endocrine secretion. It is probably a hereditary defect transmitted by a male; it is recessive in bovines. Two or more pairs of recessive genes are involved in many cryptorchid farm animals (Hafez and Hafez, 2000). Cryptorchid testes are located close to the internal inguinal ring, occasionally may be located under the skin of the ventral caudal abdomen, adjacent to and on either side of the penis, rarely in the femoral canal or in the perineal region. All retained or cryptorchid testes are small, soft and flaccid (Roberts, 1971). The incidence of cryptorchidism in buffalo is rare and Amle et al. (2004) have reported a case of cryptorchidism in a Pandharpuri buffalo calf. Inbreeding and close line breeding increases the incidence as males with this defect become physically deficient in serving ability and this influences the breeding efficiency after sexual maturity in males (Sane et al., 1994). The descent of testes involves the abdominal migration to the internal inguinal ring, passage through the inguinal canal and finally migration within the scrotum. During fetal development, testicular descent in mammals results from swelling and subsequent regression of the gubernaculum. Early in the process, the gubernaculum extends from the caudal pole of the testis to the external inguinal ring. Traction that develops from swelling of the extra abdominal portion of the gubernaculum draws the testis into the inguinal canal. Subsequent regression of the gubernaculum enables the testis to descend further into the scrotal portion. These changes are probably under hormonal control. Abnormal gubernacular development has been associated with cryptorchidism (Arthur et al., 1989; Hafez and Hafez, 2000). In bovines, the testicles pass from the abdomen to the scrotum at the stage of three-and-a-half to four months of gestation (Arthur et al., 1989). Cryptorchid testicles fail to develop completely and are non-functional because of their position, smaller size and smooth consistency. The seminiferous tubules, if formed, are rudimentary, lacking in most of the layers of reproductive cells (Jones and Hunt 1983). Cryptorchid animals are sterile owing to thermal suppression of spermatogenesis at puberty. The anatomic cause of cryptorchidism is often discovered in the form of shortened spermatic vessels, cremaster muscle or vas deferens, but the fundamental cause is commonly suspected to be hereditary (Jones and Hunt, 1983). In ruminants there is a possible association of the polled character with testicular retention (Arthur et al., 1989). The cryptorchidism in animals may be bilateral leads to sterile due to thermal suppression of spermatogenesis, where as in unilateral cryptorchid animal there is normal spermatogenesis in the scrotal testis. Unilaterally cryptorchid animals are usually fertile but have reduced sperm concentration and they display the normal secondary sexual behaviour because their testes secrete testosterone at nearly normal levels because of elevated levels of LH. Amle et al. (2004) further reported that the calf was found to be cryptorchid with both the testicles retained in the abdominal cavity instead of the scrotum. The testicles were located ectopically under the skin of ventral abdomen alongside the penis. The scrotal pouch was found empty.

Zanwar (1974) reported that 6 buffalo bulls had cryptorchid testicles (4 bilateral and 2 unilateral righ-sided) out of 97 genital organs obtained from abattoir. The retained or cryptorchid testes are usually small in size, soft and flaccid. The retained testes do not produce any spermatozoa. Spermatogenesis is inhibited by the elevation of temperature of the affected testes. Cryptorchid should never be used for breeding as it is a hereditary condition.

3.5. Unspecific sperm defects: Dag and Stump tail defect

The Dag and Stump tail defect were commonly noticed in exotic breed of cattle mainly young Jersey and Holstein bulls and were characterized by the presence of high number of unspecific sperm defects with low or absence of motility in the ejaculates (Blom, 1976) and it is also reported in Zebu and buffalo cattle (Vale, 2009). All the animals affected had a low initial sperm motility of 10-15% and very poor fertility. These bulls had about 40-50% of their sperm cells with strongly coiled, folded or split tails. The fibers in the axial filament were normal in the testis but abnormal when the cells reached to cauda epididymis. This defect was shown to be due to an autosomal recessive factor (Blom, 1976). The affected animals have high number of abnormal sperm defect about 40-50%. In Dag defect the axial fibers become abnormal and translocated or missing and the coiled tail is enclosed in a common membrane. Due to this defect the sperm showing low initial sperm motility and very poor fertility. The principle piece is involved more frequently than mid-piece (Blom, 1976). Some of these sperm abnormalities have been observed in Murrah males and it seems to be linked with the uncontrolled inbreeding in some herds of this breed (Ribeiro and Vale, 2007).

3.6. Bifid scrotum

The semen quality is affected when the testicles are close to the body because the disturbance of the thermoregulatory mechanism of the scrotum and many workers has been reported that the disturbance of this mechanism leads to increase the number of abnormal spermatozoa. In Murrah buffalo bulls, the most common variety of scrotums found are oblong type, followed by square and overlapping types. However, these are considered to be normal variants as no significant differences are noticed in semen characteristics between different types of scrotii (Somasekaram and Rao, 1986). The cases of bifid scrotum have been reported in Murrah buffalo (Rao, 1980; Kohli and Rajwanshi, 1967) due to failure of the scrotal structures at the distal end. There was 90^{o} rotation of scrotum on its longitudinal axis. The scrotum was separated at the medium phase. The testicles were rather small. The semen picture was not recorded. Clinical examination of the scrotum revealed, it to be bifid due to failure of fusion of the structures at the distal end. The scrotal sac was found to be comparatively small. The testicles were observed to be held high up in the scrotum. The median raphae appeared prominent. The testicles were symmetrical in size and normal in constancy and moved freely with in the scrotal sac. There was partial rotation of the testicles. The epididymides and accessory glands did not show any abnormality. The spermatozoa from the bulls have high incidence of proximal protoplasmic droplets and semen had showed a high percentage of abnormal spermatozoa with high head abnormalities (19%), the most prominent abnormalities present being pear shaped sperms (Rao, 1980). The seminal characteristics of bull were found to be normal in all aspects except for the presence of proportionally high percentage of sperms with abnormal head and proximal protoplasmic droplets. Since the condition continued to persist over a long period, it was reasonably suspected that spermatogenesis was to some extent disturbed in the bull (Rao, 1980). Because of the bifid of the scrotum, the scrotum rotate 90^{o} on its long axis, to the left , the left half of the scrotum had gone in front of the right half and when the animal was examined from rear it looks like a monorchid. The affected testicles are rather small and firm in consistency especially the lower half of the left testicle (Kohli and Rajwanshi, 1967). However, Somasekaram and Rao (1988) had studied the semen characteristics of 6 buffalo bulls with bifid scrotum and concluded that bifid scrotum had no effect on semen characteristics.

3.7. Preputial diverticulum

Prolapse of prepuce are not uncommon in bovine species (Frank, 1981) and preputial diverticulum has been reported in porcine species. The preputial diverticulum is very common in breeding buffalo bulls (Singh et al., 1986) and the symptoms are unable protrude the penis, the swelling enlarge on urination due to accumulation of urine which will get squeezed due to the pressure of the body while in sitting posture. The preputial diverticulum may be due to forceful thrust of the penis against the preputial fold and leads to swelling and stenosis of the preputial orifice and subsequent development of the diverticulum (Singh et al., 1986).

3.8. Congenital defect of external genitalia

3.8.1. Urethral aplasia

It denotes partial or complete absence of urethra. It is rare condition in male animals. Such condition is usually caused by segmental aplasia of mesonephric duct, which is a genetic defect. The diagnosis can be done by per rectal examination and by semen examination. Prognosis of such condition is poor and treatment is not effective and such males should not be used for breeding purpose (Roberts, 1971).

3.8.2. Pigmentation melanosis

Pigmentation melanosis of pelvic urethra has been reported in buffalo male animal (Kaikini and Patil, 1978). The entire urethral mucosa is appear deep dark chocolate brown pigmentation and this condition is associated with other defects such as bilateral segmental gonadal aplasia, bilateral spermiostasis, fusion of ampulla, segmental constriction of ampulla, fusion of vesicular glands (Blom and Christensen, 1972).

3.8.3. Scrotal or inguinal hernia

The hernia depresses the fertility by markedly interfering with the normal thermoregulatory mechanism of the scrotum and testis. It is considered as a common hereditary defect in horses and pigs; less common in bulls, dogs and rams and rare in cats. The scrotal hernias are common in the left side of the scrotum. Hernia usually appeared from birth to 30 days of age. It was considered to be a double recessive character. Animals with inguinal hernia should be castrated and not used for breeding. Reduction of the hernia and closure of the hernial ring can be performed through the inguinal canal, through an incision in the abdominal wall just cranial and medial to the ring or by a flank incision above the ring.

Raja (1962) reported azoospermia in a Murrah buffalo bull aged about 8 years. Zanwar (1974) observed degenerative changes in 66 out of 97 buffalo bull testicles obtained from an abattoir. Kodagali and Bhavasar (1973) recorded changes indicative of testicular degeneration in problem young Surti buffalo bulls. More attention must be paid by veterinarians, geneticists, animals' scientists and breeders to avoid the use of such type of congenitally defective animals for reproduction animals due to the genetic involvement of this abnormalities and transmission of it to the offspring of affected animals (Vale et al., 2002). Kaikini and Patil (1978) recorded bilateral calcification of testicles in a Berari buffalo bull. Both the testicles were hard and produced grating (metallic) sounds on incision. Pin head sized spots of calcification were observed in the substance of both the testicles. Histo-pathological changes of testicles were not reported. Testicular neoplasm does not appear to be common in bulls and buffalo bulls. Zanwar (1974) recorded the first case of testicular tumor in a buffalo bull. Three cases of testicular neoplasm were observed out of 97 testicles of buffalo bulls collected from abattoir.

4. Conclusion

The breeding soundness evaluation (BSE) plays an important step in selection of male buffalo for the purpose of artificial insemination. In buffalo breeding management program, the congenital defect and hereditary plays a critical role in determining the reproductive efficiency in buffalo bull. The genetic defect has spread to next generation from the genetic defective sire and it will cause congenital defect in offspring. To avoid this problem, cytogenetic selection is very useful. The breeding soundness evaluator should take care of genetic and congenital condition of male animal used for breeding program.

5. Future Prospects

The future prospects to improve the reproductive traits and eliminate the reproductive disorders in buffalo bulls are mentioned below.

- There is a need to greater extent to study sexual development, attainment of puberty, sexual maturity, sex libido, semen production, reproductive performance of buffalo bulls. Study of molecular marker (DNA/gene) assisted selection and cytogenetic studies linked to gene of interest with major effects on reproduction need to be strengthened for selection of breedable male in bubaline species at the early age. This cytogenic marker would help to cull/eliminate that particular bull from the herd to prevent to spread the genetic/congenital defective gene from male to future offspring and to prevent reproductive disorders.
- BSE technique would help to improve the breeding efficiency of buffalo bulls.
- Realistic remedial measures for reducing infertility and enhancing fertility need to be emphasized for the effective control of various reproductive disorders.
- Bio-safety measures for production disease free germ-plasm and registration of all artificially inseminated bulls by a national society to initiate a certified disease free semen services for the whole nation need to be addressed.

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