Current status of abortion in buffalo (Bubalus bubalis) associated with infectious agents: A short communication

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Abstract
Buffalo play a significant role in the economy of many countries. It is a multi-purpose animal, used as milk, meat and draught. Its importance increases in developing countries where, slaughter of cattle is illegal. However, the quality of meat is better than cattle. Abortions due to infection could impel the dairy and meat industry towards economic crises. The causes of abortion are multi-factorial and can be infectious (bacteria, viruses, protozoa and fungi) or non-infectious due to physical, genetic/chromosomal, nutritional, chemical, drug-induced, hormonal and miscellaneous agents. Infectious causes are more important than other. Although, all causative agents have not the same potential to cause abortion in buffalo as in cattle. Limited reports are available in this field so, needs more research.

Keywords: Buffalo, abortion, infectious causes

Introduction
The buffalo (Bubalus bubalis) is an important livestock animal. It is an economically important animal, play an important role in the economy of an Asian countries, Mediterranean region of Europe and Latin America (Barile, 2005) [16]. It is a multipurpose animal, contributing milk, meat, hide and draft power for various agricultural operations (Maherchandani et al. 2018) [48]. However, buffaloes are scandalised as poor breeders in general because of a long postpartum anestrous; late attainment of puberty and maturity (Prakash 2002) [61], which may further be complicated by abortions (Maherchandani et al. 2018) [48].

Abortion is the most important condition that limits the dam’s ability to produce a calf and considerably harms profit of the dairy industry (Maherchandani et al. 2018) [48]. It is defined as fetal death and expulsion between 42-300 days of gestation in buffalo (Hovingh, 2009) [36]. Abortion rate of 3 to 5 abortions per 100 pregnancies per year on an animal farm is often considered normal but if fetal loss is more than 3%-5% per year then it becomes a matter of concern for the owner as well as veterinarians (Maherchandani et al. 2018) [48]. In buffaloes, the incidence of abortion as reported in various studies and breeds varies from 1.51% to 7.1% (Kumar et al. 2015) [48]. The causes of abortion are multi-factorial and can be infectious (bacteria, viruses, protozoa and fungi) or non-infectious due to physical, genetic/chromosomal, nutritional, chemical, drug-induced, hormonal and miscellaneous agents (Roberts, 1985) [64].

Viral Causes of Bubaline Abortions
Bovine virus diarrhea (BVD)
Bovine viral diarrhea (BVD)/ mucosal disease complex is a syndrome of bovines having reproductive and immunosuppressive effects (Maherchandani et al. 2018) [48]. The disease is caused by BVD virus. It is transmitted by Bull semen, carrier animals are a source of infection, calves born that were infected with BVD during pregnancy may be persistently infected and are a significant source of infection to the herd (Anderson, 2007) [5]. This disease is widespread in cattle population (Anderson, 2007) [5], but also existed in buffaloes (Dehkord, 2011) [16].

Clinical Signs
Acute infections with BVDV are mild to non-apparent. Some animals in a susceptible herd may develop diarrhea and erosive stomatitis (Baker 1995) [6]. The infection of pregnant animals can occur in the first, second or third trimesters of pregnancy (Anderson, 2007) [5].
Diagnosis

History of gastrointestinal disease, however, if disease is mild, it may go unnoticed and the first signs are likely to be abortion and birth of congenitally deformed calves. The virus can be isolated from the fetal spleen. Immunocytochemical identification of BVD viral proteins in fetal tissues, especially kidney, lung or lymphoid tissue can be useful for diagnosis as it is sensitive and specific (Ellis et al., 1995) [25]. Other methods like PCR, immunohistochemistry (Driskell and Ridpath 2006) [22], and ELISA are effective (Hemmatzadeh and Amini, 2009) [34].

Prevention and Control

Disease can be controlled by constant screening and removal of persistently infected animals (Ames and Baker, 1990) [4]. Vaccination against the disease is also being used to control the disease (Bolin, 1990) [10].

Status of BVD in Buffaloes

On the basis of the sequencing of E2 region of RNA extracted from water buffaloes in the Philippines; Mingala et al. (2009) [50] reported the presence of BVDV type 1b strain which showed 92% homology with Lamspringe/738, KE9 and 2543/87 strains. Evans et al. (2016) [24] reported 4.5% sero-positivity of water buffaloes to BVDV specific antibodies. Sero-prevalence of BVDV was reported to be 72.7% in female buffaloes with reproductive disorders in Egypt (Ghazy et al. 2007) [29].

Infectious Bovine Rhinotracheitis (IBR)

Infectious bovine rhinotracheitis (IBR), also known as red nose disease, is a serious contagious herpes virus-1 (BoHV-1) disease of large ruminants (Singh et al. 2006) [71]. It is Transmitted through direct contact; aerosol or mating and the virus can persist in clinically recovered animals for years (Enquist et al. 1998) [24].

Clinical Signs

The clinical spectrum of the disease is complex in cattle and the severity of the infection and pathogenesis depend upon the virulence of the virus. There is a sudden onset of fever and anorexia, severe hyperemia of the nasal mucosa (red nose), serous discharge from the nose and the eyes, conjunctivitis, hyper salivation and a decrease in milk yield. Affected dams have numerous raised lesions on the vestibular mucosa progressing to pustules. Abortion can occur from 4 months to full term (Anderson, 2007) [5].

Diagnosis

History, clinical signs and symptoms disease are helpful for the diagnosis of disease. Immuno-histochemistry on formalin fixed tissues and ELISA (Kramps et al. 1993) [45] are used for confirmation.

Prevention and Control

Infection is controlled by using a well-planned vaccination program (Nandi et al. 2007) [48].

Status of IBR in buffaloes

Direct evidence of IBR in relation to abortions in buffaloes has not been reported, yet studies reveal that buffaloes are quite susceptible to BoHV-1. Sero-prevalence of IBR was reported to be 78.2% from female buffaloes with reproductive disorders in Egypt (Ghazy et al. 2007) [29]. Ibrahim et al. (1983) [38] isolated BoHV-1 from buffaloes in Malaysia. In India 52.2% sero-positivity for IBR was reported from southern states. An 82.4% sero-positivity for BoHV-1 in buffalo bulls was reported from Murrah and Mediterranean breeds of buffaloes from Brazil (Ferreira et al. 2010) [27], Neezal and Hassan (2017) [84] reported 40.8% sero-positivity for BoHV-1 from different parts of Baghdad in Iraq. Hedger and Hamblin (1978) [34] conducted a study on 43 different species of wildlife in seven countries in Africa and concluded that the adult buffalo population plays an important role in maintenance of BoHV-1 in wildlife. Seroprevalence of BoHV-1 in buffaloes has been reported from Malaysia, Indonesia, India, Brazil, Egypt and Italy (Fagiolotti et al. 2005) [25].

Bacterial Causes of Bubaline Abortions

Bovine Brucellosis

Bovine brucellosis is a highly contagious bacterial zoonosis worldwide (Maherchandani et al. 2018) [48]. It is caused by Brucella spp. Brucella can infect the host through the respiratory, the digestive, and the genital tracts (Kennedy and Miller 1993) [44]. Venereal transmission is not a major route of infection under natural conditions, but artificial insemination with contaminated semen can become a potential source of infection (Maherchandani et al. 2018) [48]. Worldwide, B. abortus biotype 1 is most common among the nine biotypes causing brucellosis in bovine (Cloeckaert et al. 2002) [14]. Buffaloes are known to be affected mostly by Brucella abortus and less frequently by Brucella melitensis (Samaha et al., 2008) [69].

Clinical Signs

Pregnant females in the third trimester infected with Brucella will abort, or will give birth to unthrifty calves, with retention of placenta, metritis, infertility, repeat breeding, and milk yield reduction (Maherchandani et al. 2018) [48].

Diagnosis

The organism can be identified in a stained smear prepared from suspected contaminated material. Fetal abomasal fluid, lung, placenta, uterine fluid and milk are good samples for bacterial isolation (Purohit, 2012) [62]. Special staining techniques using a modified Koster and Ziel-Neelson method is quite effective (Brinley Morgan and Mc Kinnon, 1979) [12]. The serum agglutination test (SAT), the complement fixation test (CFT), the antiglobulin test, fluorescent antibody test and immune diffusion or electro immune diffusion tests (Brinley Morgan and Mc Kinnon, 1979) [12] are also conducted for confirmation of the organism. Many real-time PCR assays have also been developed for the diagnosis of Brucella (Lopez-Goni et al. 2008) [47].

Prevention and Control

In general, prevention of brucellosis begins with the elimination of the pathogens from the animals. The following measures are important for the control of brucellosis: (I) maintenance of occupational hygiene (II) test and slaughter (III) vaccination (Nicolleti 2010) [55].

Status of Brucellosis in Buffaloes

Bubaline brucellosis was first reported in India in 1918. Later on, in 1948 first isolation of Brucella from buffaloes was reported from Egypt. Seropositivity has been reported from many countries like India, Pakistan, Egypt, Iran, Iraq, Bangladesh, Vietnam, Sri Lanka, Argentina, Brazil, Mexico,
Trinidad, Italy, Colombia, Venezuela, and Turkey and has been discussed at length elsewhere in this book (Zimmer 2014) [84]. In a study from Punjab in India, 41.17% Brucella abortus were isolated from buffaloes and the majority of isolates belonged to biotype 1. Maximum numbers of isolations in buffaloes (50%) were reported from animals that aborted at 6-8 months of gestation (Kaur et al. 2006) [43]. Successful isolation of Brucella spp. from vaginal samples of seropositive buffaloes and their confirmation through PCR has been reported from Brazil (dos Santos et al. 2017) [17].

**Bovine Venereal Campylobacteriosis (BVC)**

BVC is a venereal disease characterized by vaginitis, cervicitis, endometritis, infertility, delayed return to estrus, early embryonic death and rarely abortion between 4 to 7 months of gestation (Peter 1997) [69]. It is caused by genus Campylobacter. Transmitted by *C. fetus venerealis* inhabit the urogenital tract of sires and dams and are the main cause of reproductive tract infections (Sprenger et al., 2012) [71]. Infection occurs most often during natural mating or through artificial insemination with contaminated semen (Sprenger et al. 2012) [71].

**Clinical signs**

Infected females may have normal conception rates but later in gestation, vaginitis, cervicitis, endometritis and salpingitis develop. In bulls, *C. fetus venerealis* colonizes penile and preputial epithelial surfaces; however, it does not cause any clinical symptoms (Bier et al. 1977) [49]. In contrast, the disease is generally self-limiting in females (Truyers et al. 2014) [72].

**Diagnosis**

BVC can be diagnosed by isolation and biochemical identification of the organism (Maherchandani et al. 2018) [48] ELISA, vaginal mucous agglutination test (VMAT) and PCR are also useful with variable results (Hum et al. 1994) [37].

**Prevention and Control**

Vaccination is the most practical approach for the prevention of *C. fetus venerealis* (Truyers et al. 2014) [75].

**Status of BVC in Buffaloes**

Many researchers Isolation the campylobacters from the preputial washing of buffalo bulls, which indicates that, this organism may be widespread (Joshi et al. 2006;) [40].Cipolini et al. (2010) [13] reported a 17.5% prevalence of Campylobacter spp. in buffalo heifers from the northeastern parts of Argentina.

**Bovine Listeriosis**

Listeriosis is a bacterial disease of cattle and other animals. It can cause encephalitis, meningoencephalitis, septicemia, abortion and stillbirths in cattle. It is caused by genus *Listeria*. Infections are usually associated with feeding silage of low acidity (Anderson 2007) [5]. The organism of this disease has been isolated from buffaloes but rarely cause abortion in buffalo (Shakuntala et al. 2007) [68].

**Clinical signs**

Listeriosis mainly manifests itself in three clinical forms i.e. meningoencephalitis (i.e. circling disease), septicemia and third trimester abortion. Buffaloes are also susceptible to listeriosis where genital tract infections are common (Shakuntala et al. 2006) [69].

**Diagnosis**

Diagnosis is based on history, clinical signs, pathological lesions and detection of the pathogen. Definitive diagnosis can be made only after isolation and identification of the bacterium (Kahn 2005) [42].

**Prevention and Control**

The more effective way to reduce the risk of the disease by following the effective hygienic measures.

**Status in Buffaloes**

*Listeria monocytogenes* was first isolated from genital tracts of buffaloes in India in 1978 (Namboothiripad et al. 1978) [52] and later from aborted buffalo fetuses (Dutta and Malik, 1981) [20]. Subsequently, *L. monocytogenes* was isolated from endometritis cases in buffaloes (Nigam et al. 1999) [65], cervico-vaginal mucus samples, and meat and milk samples (Barbuddhe et al. 2002) [7]. Nigam et al. (1999) [56] reported 7.1% and 5.3 % isolation of *L. monocytogenes* and *L. ivanovii* from buffaloes having reproductive disorders.

**Bovine Leptospirosis**

The disease occurs worldwide and mainly causes abortions, stillbirths, infertility and loss of milk production (Juscicvete et al. 2017) [41]. It is caused by genus *Leptospira*. *Leptospira pomona* is the most prevalent species (Hanson 1960) [32]. The disease is contagious and infection can be transmitted directly through contact with infected urine, placental fluids, or milk, venereal or trans placentally (Ellis 1994) [22].

**Clinical Signs**

Bovine leptospirosis has been shown to manifest in terms of mainly reproductive disorders and a wide variety of conditions including fever, icterus, hemoglobinuria and abortion (from 4 month to term) (Faine et al. 2000) [26].

**Diagnosis**

The Microscopic Agglutination Test (MAT) using live antigens is the most widely used serological test, PCR and ELISA can also be used (OIE 2014) [57].

**Prevention and Control**

Acute leptospirosis can be controlled with the administration of high doses of tetracycline, oxytetracycline, penicillin, cefotiofur, tilmicosin, or tulathromycin. (Ad 2016) [2]. Controlling rodent population has been suggested for effective control of leptospirosis in human and other species (Perez et al. 2011) [58] as they are potential reservoirs for the spread of the disease, however, similar descriptions for buffaloes are not available (Maherchandani et al. 2018) [48].

**Status of Leptospirosis in Buffaloes**

Leptospirosis infections have been reported in water buffaloes in Afghanistan, Italy and Malaysia (Maherchandani et al. 2018) [48]. Water buffaloes in Trinidad have been reported to suffer from leptospirosis (Adesiyun et al. 2009) [1]. In India, leptospirosis is a major endemic disease of zoonotic importance with an overall prevalence of 10.1% among animals including buffaloes (Himani et al. 2013) [34]. In a study from south India 88% of the buffaloes were seropositive for leptospirosis and most prevalent serogroup was *L. pomona* (54.4%) (Selvaraj et al. 2005) [67].

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Protozoal Causes of Bubaline Abortions

Neosporosis
It is the common protozoal disease of cattle, buffaloes (Guarino et al. 2000) [31]. The definitive hosts of the disease are the members of family Canidae. Cattle and buffaloes act as intermediate hosts (Maherchandani et al. 2018) [48]. It is caused by Neospora caninum (N. caninum) (Dubey et al. 2002) [15]. Transmitted by both horizontally and vertically.

Clinical Signs
Water buffalo appear to be more resistant to clinical manifestations (mainly abortion) of the infection, and lesions tend to be milder as compared to cattle (Reichel et al. 2015) [63].

Diagnosis
The diagnosis of N. caninum related abortions requires the necropsy of aborted fetuses. The diagnosis can be confirmed by histology, immunohistochemistry, PCR technique, fluorescent antibody tests, ELISA, and serologic tests (Anderson, 2007) [5].

Prevention and Control
By proper hygiene, biosecurity measures and vaccination (NeoGuard™).

Status in Buffaloes
Worldwide, the seroprevalence of N. caninum infection (as a measure of exposure determined by the detection of antibody) in buffalo is higher (approximately 48%) as compared to dairy cattle (16.1%) and beef cattle (11.5%) (Reichel et al. 2015) [63]. The lesions in aborted fetuses are similar to those in bovine neosporosis cases and include non-suppurative inflammation in placenta, brain, heart and other organs (Reichel et al. 2015) [63].

Bovine Trichomonosis
It is one of the most important venereal diseases characterized by early embryonic death, post service pyometra and abortion up to 5 months of gestation in cattle (Peter 1997) [160]. It is caused by Tritrichomonas fetus (T. fetus). Buffaloes are less susceptible (Alexieva 2004) [3]. It is transmitted to the dam during mating by an infected bull and vice versa (BonDurant et al. 1994) [11].

Clinical Signs
Clinically, the disease causes chronic infertility and the incidence is higher in heifers as compared to adults or multiparous. Generally, abortion occur from three to five months but, it can occur at any time during gestation. Persistent post-coitus vaginal discharge is observed.

Diagnosis
Microscopic examination and followed by confirmation by culture of organism. PCR is also a good alternative (Anderson 2007) [5].

Prevention and Control
Segregate the infected females and culled the infected males. Use non-infected bull for natural or artificial insemination.

Status in Buffaloes
T. fetus infection of the genital tract of buffaloes has been reported from India and Egypt (Eaglesome et al. 1992) [21], however, a disease similar to that observed in cattle was not reported. Trichomonads have been isolated from buffaloes in a few studies (Jacob et al. 2007) [59] although some studies consider buffalo to be partially resistant to the infection. The isolation of Trichomonads from aborting buffaloes in Pakistan (Sanjrani et al. 2013) [66] suggests that buffaloes might be affected with trichomoniasis although in lesser frequency compared to cattle. A commercially available vaccine for prevention of trichomoniasis.

Other Infectious Causes of Bubaline Abortions
The pathogens that discussed above mainly related to the abortion in buffalo. By a nested-PCR assay, three of 14 vaginal swabs from aborted animals tested positive for Chlamydia agents and, additionally, three out of seven aborted fetuses tested positive for Chlamydia spp., with two being co-infections by Cp. abortus and Cp. pecorum and one being characterised as Cp. Abortus (Greco et al. 2008) [30]. The anti-Chlamydiaceae antibodies were also present in more than half of the aborting animals. (Greco et al. 2008) [30].

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