Common infectious abortion in cattle

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Abstract: Abortion is expulsion of a dead fetus in the middle of gestation, in cattle between 42 and 260 days of gestation. Infectious abortions in cattle are caused by Bacterial, Viral, Protozoal and Fungal diseases. In the infectious abortions, the most common that have high abortion rate or persistent infection includes *Brucella abortus*, *Bovine viral diarrhea*, *Trichomonas foetus* and *Aspergillus fumigatus.* All these causative agents bring economical loss in terms of cost of treatment, infertility, abortion, rebreeding and culling of the cows. Abortion in cattle may also involve a very considerable public health risk, as many of the pathogens responsible for abortion can pose a significant danger to human health. Thus rapid, accurate diagnosis is vital in order to be able to reduce the risk to animals and humans and to assess the degree of risk caused by potential ruminant abortifacients with *zoonotic* potential such as *Brucella spp, listeria monocytogenes* and *Salmonella spp.* Treatments have no value in the case of some the infectious abortion, because of intracellular natures which develop drug resistant. Therefore, effective diagnosis of infectious abortion is helpful to implement appropriate prevention and control strategies. Proper management, vaccination, education of the owner and using artificial insemination is crucial to reduce these diseases.
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1. Introduction

Abortion is expulsion of a dead fetus in the middle of gestation, in cattle between 42 and 260 days of gestation. If death occurs at 1-2 month of gestation, it is usually termed “early embryonic death” (Bagley, 1999). The greatest risk of fetal loss is during the first trimester of gestation and then progressively decreases as gestation advances with a slight increase in the risk toward the last month of gestation. The infectious causes include bacterial, fungal, viral and protozoa (Peter, 2000).

Reproductive diseases are important causes of economic loss to the cattle livestock industry. These losses are due to abortions, repeat breeding, and cost of treatment and transmission of infectious agents among the herd. Of these factors, it has been estimated that up to 90% of these loses are due to infectious agents (Sharma *et al.,* 2008). Abortion is the most important condition that limits cows’ ability to produce a calf and considerably erode profit of producers (Peter, 2000). However, the abortion incidence rate varies widely depending on the health status of individual herd (Sharma *et al.,* 2008). Fundamentally, it needs adjusting husbandry of cow and beef cattle with the time of reproduction without delay. Infertility and low quality and quantity of fertility become daily animal husbandry problem; generally, fertility reduction and abortion considered as a basic problem in dairy cattle rearing industry (Ebrahim *et al.,* 2012).

Abortion in cattle may also involve a very considerable public health risk, as many of the pathogens responsible for abortion can pose a significant danger to human health. Thus rapid, accurate diagnosis is vital in order to be able to reduce the risk to animals and human and to assess the degree of risk caused by potential ruminant abortifacients with *zoonotic* potential such as *Brucella spp, listeria monocytogenes* and *Salmonella spp* (Mora *et al.*, 2007). This needs updating knowledge and raising awareness; therefore, this review is on common infectious causes of abortion in cattle with the following objectives:

- To address the pathogenesis and diagnosis of common infectious abortion in cattle.
- To introduce economic impact of common infectious abortions.
- To inform *zoonotic* importance of common infectious abortions.

2. Common Infectious Abortion In Cattle

There are a number of bacterial, viral, fungal and protozoal causes of abortion. Based on the abortion rate or persistent infection the common infectious abortions in cattle are *Brucella abortus*, *Bovine viral*

diarrhea virus, Aspergillus fumigatus and *Trichomonas foetus* (Radostits *et al.,* 2007).

2.1. Bacterial Causes of Abortion

There are a number of bacteria that causes abortion in cattle with different level of clinical picture, time of abortion and abortion rate (Table 1). Of these bacterial abortions brucellosis accounts the highest abortion rate (Radostits *et al.,* 2007).

Table 1: Common bacterial abortions their clinical pictures and time of abortion based on their rate of abortion in cattle

Disease	Clinical feature	Time of abortion	Abortion rate
Brucellosis (*Brucella abortus*)	Ss metritis, chronic infection	Third trimester	High, up to 90% in susceptible herd
Leptospirosis (*Leptospira hardjo)*	Abortion may occur at a cut febrile stage.	Abortion may occur though out gestation, late 6 month	25-30%
Listeriosis (*Llisteria monocytogens)*	Cows that abort may die of septicemia near term. Retained placenta and metritis.	About 7 month	Low, rare abortion storms related with poorly fermented silage

Source: Radostits *et al.,* 2007

2.1.1 Brucellosis

Brucellosis is an infectious abortion caused by bacteria called *Brucella abortus*. At least nine biotypes of *Brucella abortus* have been recognized including a number of strains. Aproximately 5% of infection are from biotype 1, biotype 2 was isolated in an outbreak of brucellosis. The disease is transmitted by ingestion, penetration of intact skin and conjunctiva, and contamination of udder (Radostits *et al*., 2007). Although acquired most often by ingestion, infections can occasionally acquire through venereal contact, inhalation or transplacental transmission (Quinn *et al*., 2002).

Pathogenesis

The establishment and the outcome of infection with *brucella* depend on the number of infecting organism and their virulence and also on host susceptibility. Virulent *brucellae,* when engulfed by phagocytes on mucous membranes, are transported to regional lymph nodes. *Brucella* persist with macrophage but not with in nutrophil. Inhibition of phagosome-lysosome function is a major mechanism for intracellular survival and important determinant of bacterial virulence. Various stress proteins are thought to allow the organism to adapt to the harsh conditions encountered with in macrophage. Super oxide dismutase and catalase production may play a role in resistance to oxidative killing (Quinn *et al.,* 2002).

If the infected animal animals are pregnant, *Brucella abortus* colonize and replicate to the high numbers in the chorionic trophoblasts of the developing fetus. The resulting tissue necrosis of the fetal membranes allows the transmission of the bacteria to the fetus. The net effect of chorionic and fetal colonization is abortion during the last trimester of pregnancy. Sexual immature and other non-pregnant cattle can become infected but lose their humoral antibody to the organism much more quickly than cattle infected while pregnant. In the adult, non pregnant cow, localization occurs in the udder, and the uterus, if it becomes gravid, is infected from periodic bacteremic phase originating the udder. Erythritol, a substance produced by the fetus and capable of stimulating the growth of *Brucella abortus*, occur naturally in the greatest concentration in the placental and fetal fluids (Radostits *et al*., 2007).

Clinical signs

Intercotyledonary thickening with a yellow gelatinous fluid is present. The cotyledons are frequently necrotic, yellow gray in color and covered with thick brown exudates when we observe during post mortem examination. The aborted fetuses have no visible lesions on gross postmortem examination (Hrish and Zee, 1999). Retention of the placenta and metritis are common sequelae to abortion. In bull, orchitis and epididymitis occur occasionally (Radostits *et al*., 2007).

Diagnosis

Antibody detection is commonly used for diagnosing brucellosis. Sample tested include blood, milk, and occasionally semen. A number of immunodiagnostic tests have been developed for cattle. These tests detect different classes and types of antibodies and vary in their sensitivity and specificity. Individual blood sample can be tested by tube agglutination, plate agglutination, rose Bengal plate, or card test (Hirsh and Zee, 199).

Clinical sign are not specific although abortion in first calf heifers and replacement animals may suggest the presence of the disease. Isolation and identification of *Brucella abortus* is confirmatory. Identification criteria for isolate include colonial appearance, MZN positive organism, bacterial cell agglutination with a high titred antiserum, rapid urease activity and

biotyping using test. Clusters of MZN positive cocco bacilli may be evident in the smear of cotyledons and positive organisms may also be detected in fetal abomasal content and utrine discharge. Brucellin, an extract of *Brucella abortus*, has been used for intra dermal testing. Molecular method, such as PCR-based techniques, for the detection of *brucella* in tissue and fluids has been described (Quinn, 2002).

Treatment and control

As a general rule, treatment of infected livestock is not attempted because of the high treatment failure rate, cost, and potential problems related to maintaining infected animal in the face of ongoing eradication programs (Hirsh and Zee, 1999). Treatment is unsuccessful because of the intracellular sequestration of the organism in the lymph node, the mammary gland, and reproductive organ. All breeding cattle in the herd are tested and those that are positive are culled and sent for slaughter. For control and prevention quarantine which means cattle movement is restricted and cattle are tested. Vaccinated cattle are less likely to be infected, and, Therefore, are not a source of field strain of the organism (Radostits *et al.,* 2007).

2.2. Viral Causes of Abortion

There are number of viral causes of abortion in cattle (Table 2). Of these viral causes of abortion Bovine viral diarrhea cause highly a persistent infection in cattle (Murphy *et al.,* 1999).

Table 2: Major viral cause of bovine abortion

Cause	Stage of gestation	Diagnostic test
Bovine herpes virus1, IBR	Fifth to ninth month	Histopathology, virus isolation, FA test of frozen fetal kidney
Blue tongue, Orbivirus	Any stage	Pathology, virus isolation, fetal serology
BVD virus, pestivirus	Any stage	Pathology, FA test on fetal tissue, fetal serology
EBA, Foot hill abortion	Third trimester	Pathology

Source: Smith, 2009

2.2.1 Bovine viral diarrhea

Bovine viral diarrhea is caused by bovine viral diarrhea virus. This virus is classified as *pestivirus* with in the *flaviviridae f*amily and can cross the placenta and damage the fetus (Andrews *et al,* 2004). BVD can produce early embryonic death, fetal anomalies, or abortion. Isolate from bovine aborted fetuses are usually noncytopathic (Smith, 2009). BVD virus is shed in the nasopharyngeal secretions, urine and perhaps by aerosol droplets. Feces are a poor source of virus (Andrews *et al*., 2004).

Pathogenesis

BVDV may be shed in most body secretions. The effect of exposure to BVDV varies greatly depending on the gestational time during which exposure occurred. In seronegative cows, exposure to BVDV at the time of breeding prevents conception. Placental attachment at approximately 35 days of gestation seemingly must precede fetal infection. During the first 4 month of gestation, infection usually causes fetal death and abortion. Fetuses that survive in infection with noncytopathic strains between 18 and 125 days gestation will be persistently infected are typically seronegative at birth, and subsequently shed BVDV continuously. They may develop mucosal disease later in the life from super infection with cythopatic BVD virus. Fetuses infected at between 100 and 150 days gestation, considered congenitally infected, are at the risk for the development of dysplastic lesion including teratogenic defect in the brain, skin, or bronchioles. Fetuses are infected after 150 days usually recover without dysplastic lesion. Recent evidence, however, suggests that those fetuse born with neutralizing titers to BVDV are more likely to develop a serious illness with in the first 10 month f life and less likely to conceive as heifers than those calves born without neutralizing titers to BVDV (Smith, 2009).

Post natal infection of the young or growing animal with noncythopathic virus is usually a subclinical event. In most herds where the virus is present, there is no disease related problem. However, infection of the seronegative pregnant cow prior to 120 days of gestation, before the immune system of the fetus has become fully developed, can result in disease. When the virus has crossed the placenta, the fetus become infected and may result in abortion, mummification or early fetal death (Andrew *et al.,* 2004).

Clinical sign

The clinical and pathologic manifestations of infection in individual cattle vary with age and pregnancy status. Three situations are considered: post natal infection in non pregnant cattle, infection in pregnant cows, and persistent infection in calves and mucosal disease (Murphy *et al.,* 1999). Although fetal death is most common during the first trimester, abortion can occur at any stage of gestation (Smith, 2009).

Diagnosis

The aborted fetus may have a variety of dysplastic lesion, including cerebellar hypoplasia, cerebral malformation (hydrencephaly, porencephaly, microencephaly) and cataracts. Microscopic lesions

include a mild nonsuppurative placentitis, nonsupurative vasculatis may be observed in the placenta, liver, or lymph node. Virus isolation from fetal tissue is seldom successful, likely because of the protracted time before fetal expulsion generally occurs after infection. Viral antigen may be detected by FA test on kidney, lung, or lymph node. Virus neutralization and ELISA are used to detect antibodies in fetal thoracic fluid, which indicate prenatal exposure to the virus but do not necessarily incriminate BVDV as a cause of abortion. Maternal titers are seldom of diagnostic value because arise in titer generally occur before abortion (Smith, 2009).

A presumptive diagnosis can be made on the basis of clinical history, examination of herd reproduction records, clinical signs, and gross and microscopic lesions. Viral antigen and RNA detection in tissue by the reverse transcription-PCR is also possible. Specimens for virus isolation include feces, nasal exudates, blood and tissues collected at necropsy, and aborted fetuses. Immunofluorescence may be used to detect viral antigen in cell cultures and tissues (Murphy, 1999).

Treatment and control

There is no effective treatment for BVD. If the disease is suspected all efferts should be towards a diagnosis so that effective control measure may be instituted (Andrew *et al.,* 2004). BVDV is not fully controlled with vaccination. Herd health plans must focus on elimination of persistently infected animals and prevention of new PI animals being introduced into the herd (Smith, 2009).

2.3 Protozoal Causes of Abortion

There are protozoal causes of abortion in cattle; similarly, they have different rate and time of abortion (Table 3). Of the protozoal causes of abortion, *Trichomonas foetus* causes persistent infection in cattle (Urquhart *et al*., 1996).

Table 3: Protozoal causes of abortion their abortion rate and time of abortion

Disease	Abortion rate	Time of abortion	Laboratory diagnosis
Trichomonosis (*Tricomonas foetus)*	Moderate, 5-30%	Primarily first 5 month	Cervical mucus agglutination test. Microscopic examination. Serology rarely performed.
Neosporosis *(Neospora caninum*)	Sporadic out breaks common (20-40%).	3-8 month of gestation (mean 5.5 months)	IFAT and ELISA antibodies used for serological detection.

Source: Radostits, 2007

2.3.1 Trichomoniasis

The most important pathogen in this genus is *Trichomonas foetus,* a venereally transmitted, multiflagellated organism of the reproductive tract of cattle. In bulls, infection is in apparent, but in pregnant cows it produces early fetal death which is usually recognized as an infertility problem (Urquhart *et al*., 1996). *Trichomonas foetus* is found in the vagina, uterus, macerated fetus, prepuce, penis epididymis, and vas deferens. The organism displays considerable pleomorphism, varies from 10 to 25 µm in length, and has three anterior flagella and along, trailing flagellum that extends beyond the undulating membrane (Bowman *et al.,* 2003).

The organism is pear shaped and has a single nucleus and four flagella, each arising from a basal body situated at the anterior rounded end. Three of the flagella are free anteriorly, while the fourth extends backwards to form an undulating membrane along the length of the organism. In fresh preparation, the organism is motile and progress by rolling jerky movements, the flickering flagella and the movements of the undulating membrane being readily seen (Urquhart *et al.,* 1996).

Pathogenesis

Bulls, once infected, remain so permanently. The organism inhibits the preputial cavity and transmission to the cow occurs during coitus. From the vagina, the *trichomonads* reach the uterus via the cervix to produce a low grade endometritis. Intermittently, organisms are flushed in to the vagina, often two or three days before oestrus. Infection is usually followed by early abortion, the organisms being found in the amniotic and allantoic fluid. Subsequently cows appear to self cure and, in most cases, appear to develop a sterile immunity. In the bull, a preputial discharge associated with small nodules on the preputial and penile membranes may develop shortly after infection. There after there are no clinical sign or lesions. In the cow, abortion before the forth month of pregnancy is the commonest sequel and this normally followed by recovery. Occasionally the developing fetal membranes are retained leading to a purulent endometritis, a persistent uterine discharge and an oestrus; in frequently the corpus luteum is retained and the cervical seal remain closed, when a massive pyometra develops which, visually, simulates the appearance of pregnancy (Urquhart *et al*., 1996).

Clinical sign

In the bull, there are no clinical signs once the infection is established. In the cow, early abortion is a characteristic feature although this is often undetected because of the small size of the foetus and the case may present as one of an irregular oestrus cycle. Other clinical signs are those of purulent endomeritis or a closed pyometra and, in these cases, the cow may become permanently sterile (Urquhart *et al.,* 1996).

Diagnosis

Diagnosis is by finding the organisms in washings from its predilection sites or from the stomach of the aborted fetus. Fluid material should be centrifuged at 2000 rpm for five minutes. The supernatant is then removed and a drop of sediment transferred to a slide for microscopic examination for the organisms. For more accurate diagnosis, fluid material from the predilection sites can be cultured in a special medium (Hendrix, 1998).

Vaginal mucus collected from the anterior end of the vagina by suction in to a sterile tube, or preputial washings from the bull, may be examined using a warm-stage microscope for the presence of organisms. However, since the organism is often only present intermittently, the examination may require to be repeated several times. Alternatively, on the herd basis, sample of vaginal mucus may be examined in the laboratory for the presence of specific agglutinins against laboratory cultures of *Tricomonas foetus* (Urquhart *et al.,* 1996).

Treatment and control

Since the disease is self limiting in the female only symptomatic treatment and sexual rest for three months is normally necessary. In the bull, slaughter is the best policy, although dimetridazole orally or intravenously has been reported to be effective. Artificial insemination from non-infected donors is the only entirely satisfactory method of control. If a return to natural service is contemplated, recovered cows should be disposed of since some may be carriers (Urquhart *et al.,* 1996).

2.4. Fungal causes of abortion

There are a number of fungal causes of abortion in cattle, but Aspergillus fumigatus is mainly responsible for fungal abortion in cattle.

2.4.1 Aspergillosis

Fungal placentitis due to *Aspergillus spp* (septic fungi, 60-80% of the case), *Mucor spp, Absida or Rhizopus spp* (non septate fungi) is an important cause of bovine sporadic abortion (Kahn *et al.,* 2005). It is estimated that *Aspergillus fumigatus* is responsible for 90-95% of *Aspergillosis* infection in animal. Other Aspergillus species that occasionally cause infection include *Aspergillus niger*, *Aspergillus flavus* and *Aaspergillus nidulans* (Quinn *et al*., 1994). Aspergillosis is acquired from environmental source; generally transmission is by inhalation or ingestion (Hirsh *et al*., 2004).

Pathogenesis

It is believed that the fungi gain entry through the oral or respiratory tracts and travel hematogenously to the placenta. Placentitis is sever and necrotizing. Cotyledons are enlarged and necrotic with turned in margins, the intercothledonary area is thickened and leathery, adventitious placentation is common. The fetus seldom is autolyzed, although it may be dehydrated; so have gray ring worm like skin lesion principally involving the head and shoulders (Kahn *et al.,* 2005). On mucosal surface (nasal passage, trachea) mold colonies from on the top necrotic tissue, which is surrounded by hemorrhagic zone is observed (Hirsh *et al,* 2004). *Aspergillus fumigatus* produce haemolysin, proteolytic enzymes and other toxic factor but their role in the pathogenesis of aspergillosis is not known (Quinn *et al.,* 1994).

Clinical sign

The clinical sign include necrosis of maternal cotyledon, adherance of necrotic material to chorionic cotyledon cause soft, yellow, cushion like structure. Small yellow, raised leathery lesions on intercotyledonary area (Radostits *et al.,* 1994).

Diagnosis

Specimen should include pneumonic lung, granulomatous nodules, fetal lesion, foetal stomach contents, cotyledons and fungal plaques in the gultural pouch. Tissue scraping and other material can be examined by direct microscope after clearing in 10% KOH. Sabouraud dextrose agar, with and without 0.05 g/L *chloramphenicol* is used for isolation. *Aspergillus fumigatus* has white fluffy colony when it first appears, rapidly becoming velvety or granular and bright bluish-green in colour. Older colonies can assume a smoky battle-ship grey colouration. In *Aspergillus fumigatus* conidiophores are moderate in length and have a characterstic foot cell at their bases when mounts are made in LPCB from the colony and seen in microscope. Commercial immune diffusion kit for the serological diagnosis is available. Primer designed to amplify DNA encoding ribosomal RNA are available for demonstration or identification of members of the genus. Amplification of DNA is by the PCR (Hirsh *et al.,* 2009).

Treatment and control

*Itraconazol*e has been beneficial in treating disseminated *aspergillosis.* For control avoidance of massive exposure requires elimination of cattle feed, particularly hay and silage that has under gone noticeable deterioration (Hirsh *et al*., 2004).

3. Economic Impact Of Abortion

The economic impact of abortion depends on direct cost and value of the fetuse lost. Indirect costs

include those associated with establishing the diagnosis, re-breeding cows that aborted, possible loss of milk yield and replacement costs if cows that aborted culled. Aborted cows are at 3.2 times higher of being culled; aborted cows if not culled have five time more likely to abort sub sequentially than cows that never aborted. If one calculates the conception to conception interval, it is 173 days on an average. On average it takes 72 days for cow to conceive after an abortion, however, there is a gestation age effect. As gestational age increased, time to rebreed increased. In the first trimester abortion it took 54 days to rebreed and 85 days in the second semester abortion and 116 days in the third semester abortion. The basis of cost estimation are to determine the numbers of days open plus the gestational days at the time of abortion. It can range from 150 to 225 days or more for a herd (Peter, 2000).

Cost of open day estimate can be used to obtain the loss and inclusion of veterinary intervention and medication can provide the total loss due to abortion. There are no conclusive data regarding economic losses to the cattle industry caused by *neosporosis* anywhere in the world. The best available figure is that 20 to 30% of all abortion in California is caused by infection with *Neospora caninum.* It has been estimated that economic loss in California directly related to *Neospora caninum* are approximately $ 35 million each year and this is based on 40,000 abortions caused by this organism. The dairy population is 1.2 million and 5 to 15% of the pregnancies are aborted. Each midterm abortion costs the producer between $ 600 and $ 1000. The other losses include the reduced production of milk by seropositive cows. They produce 1k.g less than their seronegative herd mates. It is also possible that cows were culled 6 months sooner than where seronegative cows (Peter, 2000). A high incidence of temporary and permanent infertility results in some death as a result of acute metritis following retention of placenta (Radostits *et al*., 2007).

4. Conclusion And Recommendations

There are a number of infectious abortions caused by bacterial, viral, fungal, and protozoal agents. Brucellosis, bovine viral diarrhea, aspergillosis, and trichomoniasis are the most important infectious abortions listed from bacterial, viral, fungal, and protozoal abortions, respectively. Of the infectious causes of abortion, agents like *Brucella spp, listeria monocytogenes* and *Salmonella spp* have important zoonotic potential and public health impact. Most of the diseases that cause abortion have no treatment. Hygienic management and pre-vaccination helps to reduce the incidence of the disease.

Therefore, based on the above conclusion the following recommendations are forwarded.

- As most causes of infectious abortion have no treatment, individuals working in cattle industry should be informed about the risk of these infectious diseases and to keep hygienic management during their practice.
- Cattle owners should aware the advantage of quarantine, vaccination, elimination of persistently diseased animals and prevention of new coming infected animals to reduce their farm from infectious causes of abortion.
- Milk contaminated by infectious causes of abortion can be source of infection for humans; therefore, the public should aware to pasteurize milk before consumption.

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