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Research article

Infectious Causes of Abortion and its Associated Risk Factor in Sheep and Goat in Ethiopia

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Abstract

Several causative infectious agents are responsible for abortion causes in sheep and goats. The economic and zoonotic significance of infectious causes of abortion remains of concern in developing countries. Abortion in general causes substantial losses of productivity through death and expulsion of a fetus by the ewe/doe before the end of a normal term of pregnancy, affect the future fertility, lactation and flock are culled annually. Common infectious causes of abortion in small ruminants include brucellosis, leptospirosis, listeriosis, Q fever, toxoplasmosis, and salmonellosis. Abortion also caused by noninfectious situations such as genetic factors and mechanical conditions. Age, flock size, species composition, the hygienic status of the farm and environmental factors were risk factors for abortion in sheep and goats. In general, there is a lack of information about small ruminant abortion in Ethiopia. This paper reviewed the common cause of abortion in sheep and goats, the public health significance, the risk factors and the status of sheep and goat abortion in the country. The risk factors for the occurrence of abortion and lastly, different approaches for the control and prevention of abortion were discussed.

Keywords: Abortion; Causes; Risk factor; Sheep; Goat

INTRODUCTION

Livestock serves as one of the main pillars of developing countries playing imperative economic, social and cultural roles for the pastoral/agro-pastoral families once they contribute to generate income and well-being of the farmers [1]. Ethiopia is known by a huge number of ruminants in Africa including a cattle population of 56.83 million, 28.89 million sheep, and nearly 29.7 million goats [2]. However, the rate of urbanization is high, which places challenges on farmers and the government to meet the demand for livestock products for an increasing population. To increase livestock productivity and satisfy the increasing demand for livestock products, Ethiopia has prioritized breed improvement, pasture development and animal health [3].

However, reproductive health problems are becoming the major obstacles for this development plan [4-6]. Reproductive disorders affect sheep and goat producers' by reducing the productivity of food production and impacting the persistence of threatened animal species. Among the reproduction problem, abortion is one of the major problems for improving reproduction value in sheep and goats. Abortion in sheep and goats is represented an important economic losses etc. [4].

In Ethiopia, the constraint of small ruminants includes low production, scarcity of feed, slow growth rate, high mortality, veterinary service delivery constraint and diseases associated with reproduction have a great impact on production and productivity [1]. Also, the extent of economic loss due to reproductive health problems and its associated risk factors were not clear yet known [7].

Infectious reproductive diseases of sheep and goats are one of the major health problems which cause abortion. These diseases usually manifest infertility, irregular cycling, abortions, fetal mummification, and stillbirth. Although there are numerous causative infectious agents such as bacteria, viruses and protozoa are responsible for cause abortion in sheep and goats. Abortion also caused by non-infectious situations such as toxicities, genetic factors, metabolic and nutritional problems, physical factors and may have a significant impact on the overall productivity of sheep and goats [4]. Hence, this paper aims to review infectious causes, status and risk factors of abortion in sheep and goat in Ethiopia.

ABORTION IN SHEEP AND GOATS

Abortion is defined as the expulsion of a fetus before the end of a normal term of pregnancy. This is the most important cause of reproductive failure and considerable economic losses in sheep and goats production [8]. Abortion reduces sheep and goat productivity in the world and it causes infertility, reduced milk, and culling of animals. These condition results in considerable economic losses to the sheep and goats production due to uterine infections, reduce productive rate, prolonged inter-conception and lambing/kidding interval, infertility, veterinary cost, reduce milk production, and early reduction of potentially used ewes and does [9].

Common infectious causes of abortion in sheep and goat

Brucellosis: *Brucella* species are small, gram-negative, intracellular bacteria which usually cause a chronic infection that lasts for the life in animals [10,11]. Brucellosis in small ruminants is mainly caused by *Brucella melitensisi* and *B. ovis* and in sporadic cases *B. abortus*. Brucellosis is one of the serious zoonotic diseases. *B. melitensis* is most commonly infects sheep and goats. Breed susceptibility is variable in sheep, but goat breeds are highly susceptible [12]. *Brucella* infection in sheep and goats is widespread worldwide. However, the disease is a serious problem in developing countries [13].

The prevalence of brucellosis is influenced by several risk factors associated with production systems, the biology of the individual host and environmental conditions. These include age, flock size and composition, the hygienic status of the farm, the rate of contact between infected and susceptible animals, farm biosecurity and climate [10,14].

The mode of transmission of *B. melitensis* in sheep and goats is similar to that in cattle but sexual transmission possibly plays a greater role. The transmission of the disease is facilitated by the coming of flocks and herds belonging to different owners and purchasing animals from unknown sources. Materials expelled from the female genital tract are the main supply of *Brucella* organisms for transmission to other animals and humans [15].

The major clinical signs of brucellosis in sheep and goats are a reproductive failure, abortion, and stillbirth. Abortion due to brucellosis commonly occurs during the last two months of the gestation period and sometimes it tracked by retained fetal membranes. In the male, localization in the testicular organs, epididymis and accessory sex organs is common, and bacteria may shed in the semen. This condition may result in acute orchitis and epididymitis and impending to infertility [16]. Inactive cases, brucellosis in small ruminants can be diagnosed by isolation and identification of responsible micro-organisms using bacteriological, molecular and serological tests [16].

The control of brucellosis can be achieved by using vaccination to increase the population's resistance to the disease [17]. It is usually accepted that a programmed of eliminating brucellosis by test and slaughter policy when the prevalence of infected animals in an area is about 2% or less than 2% [16]. Human brucellosis is usually prevented by controlling the infection in animals and pasteurization of dairy

products [18]. In general, level brucellosis prevalence studies have been conducted in different parts of the country. Even though, there is slight information on specific transmission dynamic forces within different agroecology in the country. Prevalence studies in the country were largely restricted to bovine brucellosis and infrequently in sheep and goats. The identification of *Brucella* species in the country was ineffective, the distribution and proportion of their natural hosts were also not studied thoroughly [18].

Toxoplasma gondii: *Toxoplasma gondii* is an intracellular protozoan organism with a large number of intermediate hosts that belong to the family *Sarcocystidae* and Genus *Toxoplasma*. *Toxoplasma gondii* has a nucleus that demonstrated with Giemsa stain, located near one pole of the cell [19,20].

The life cycle of *Toxoplasma gondii* alternative between two hosts, definitive (sexual reproduction) and intermediate (asexual replication) hosts. The oocyst ingested by humans, herbivores and chicken release sporozoites that develop into tachyzoites that can invade and multiply by sexual reproduction and then migrate to tissues to form tissue cyst bradyzoites [21]. Humans can get an infection in two ways, consumption of oocyst from the cat with contaminated water, food and soil, and ingestion of bradyzoites in infected flesh [22]. Trans placental, tachyzoites infect a fetus in pregnant women [23].

Toxoplasma gondii infection in man and animals is widespread throughout the world but varies in different geographical areas of a country. Causes for these variations are not yet known. Environmental conditions may determine the degree of the natural spread of *Toxoplasma gondii* infection. Infection is more prevalent in warm climates and low-lying areas than in cold climates and mountain regions and humid areas than in dry areas. This is probably related to conditions favoring the sporulation and survival of oocytes in the environment [20].

Toxoplasma gondii causes abortion and neonatal mortality in sheep and goats worldwide. it is congenitally infected lambs that survive the first week after birth usually grow asymptomatic while adult goats can develop clinical toxoplasmosis involving the liver, kidneys, and brain [20]. In sheep and goats, a primary infection established during pregnancy may result in infertility, stillbirths, and abortion, according to the stage of a pregnancy at which infection was initiated. In a typical case of abortion, a ewe or doe infected in mid-gestation produces a stillbirth lamb/kid a few days earlier than the predicted end of pregnancy. The aborted fetus is often accompanied by either a weak sibling or a 'mummified' fetus [24].

Some studies conducted in the different geographical locations of Ethiopia indicated that high seroprevalence of *Toxoplasma gondii* infection in sheep and goat. Other studies have reported overall seroprevalence of 19.5% [25] and 24.1% [26] of toxoplasma antibodies in sheep and goats respectively. The serological study conducted by [27] indicated that 74.9% of the prevalence of *Toxoplasma gondii* was recorded in the central and southern regions of Ethiopia. A recent study conducted in southern Ethiopia reported the seroprevalence of 26.09% *Toxoplasma gondii* antibodies in sheep and goats [28] and 20.5% in central Ethiopia [29].

Listeriosis: *Listeriosis* is a serious and life-threatening disease caused by *Listeria monocytogenes*. Listeria species are gram-positive intracellular bacteria that are distributed in the environment and grow over a wide range of pH and temperature. The genus is composed of six species; three of which *Listeria monocytogenes*, *L. ivanovii* and *L. innocua* are pathogenic. *Listeria monocytogenes*, the most important of these three pathogens, has been implicated worldwide in diseases of many animal species and human [30]. Listeriosis is a disease of ruminants; particularly sheep and the major disease associated with *Listeria monocytogenes* are encephalitis and abortion. It also produces syndromes of septicemia, myelitis, uveitis, gastroenteritis, and mastitis [31].

The organism is abundant in the environment and commonly isolated from animal and human feces, slurry, sewerage sludge, soil, contaminated water, animal feeds, floors, drains and other farm and environmental factors. The main transmission is soil contamination and the ingestion of contaminated feed is the primary mode of transmission of *Listeria* infection [32].

Listeriosis in small ruminants may present as encephalitis, abortion, septicemia or endophthalmitis, but mainly takes the form of meningoencephalitis, called circling disease in its most common form. Affected animals circle, in one direction only and display unilateral facial paralysis, difficulty in swallowing, fever, blindness, and head pressings. Paralysis and death follow in 2 to 3 days [33]. Usually, only one form of the disease occurs in a group of affected animals. Septicemia is often encountered in neonates and can also occur in adult sheep [30]. In pregnant animals, *Listeria monocytogenes* may confine in the placentas and in the amniotic fluid. It multiplies there and is ingested by the fetus, eventually causing fetal death and abortion. Abortion usually occurs in the late gestation period [33].

Abortion is common in ruminants usually late term-after 12 weeks in sheep. The fetus may be macerated or delivered weak and moribund. Retained placenta and metritis may be resulted [33]. Outbreaks of abortion occur more commonly in sheep and goats and there will be a blood-stained reproductive tract expulsion for several days. Death may occur in ewes and does due to septicemia if the fetus is retained. The rates of abortion in both species, in a group, are lower but may reach as high as 15%. In some affected farms, abortion returns each year [30].

Leptospirosis: Leptospirosis is a worldwide important zoonotic disease caused by pathogenic gram-negative bacteria of the genus *Leptospira*. It is the major cause of reproductive losses in farm animals. *Leptospira interrogans* is a pathogenic species that cause leptospirosis [34]. *Leptospira spp* have characteristic hooked ends and are firmly twisted with approximately 18 coils per cell. *Leptospira spp* are aerobic, catalase and oxidase-positive [35].

Leptospirosis occurs particularly in the tropical and subtropical regions, where environmental conditions favor the survival of the organism and transmission of the disease. It affects practically all animals and is transmitted direct or indirect depending on the immediate source of infection [36]. Leptospirosis is a major cause of economic losses in animal production at the farm level. The major clinical signs of leptospirosis are subclinical, mostly associated with the infectious level causing abortion, stillbirth, and birth of weak offspring with the highest rate of death in sheep and goats [10].

The diagnosis of leptospirosis depends on the samples offered and the progressive stage of the sickness. The laboratory tests used for diagnosis of leptospirosis are microscopic examination, cultural isolation, molecular method, serology and inoculation of animals in the laboratory [37].

Leptospirosis can be treated by antibiotics such as tetracycline,

penicillin, ampicillin, doxycycline, streptomycin, and erythromycin [38], while the prevention of leptospirosis is characterized by hygienic control and minimizing the risk to infection which occurs due to animal contact with contaminated environments, infected wild animals as well as with synanthropic animals and rodents [34]. Control measures of leptospirosis are expected at limiting the occurrence of clinical disease based on combined activities in several links of the transmission sequence [39]. So far, few documented information regarding the occurrence of leptospirosis in animals in Ethiopia, climate, socioeconomic and other leptospirosis factors are mainly favorable for the occurrence and spread of the disease in the country.

In Ethiopia leptospirosis has been reported to occur in domestic animals [36] with a prevalence of 47.3% in goats and 43.4% in sheep. In humans [40] reported from a total of 59 patients admitted the outpatient of Wonji Hospital, 47.46% of the patients were positive leptospirosis and the occurrence of the disease was more common in males than females. According to [41], a total of 184 out of 418 horse samples had antibody titers of 1:100 or greater to at least one of 16 serovars, indicating the presence of 16 serovars of *leptospira* species in horses in central and southern Ethiopia. This indicated that 44% of sampled horses were seropositive to at least one serovars.

Salmonella spp: *Salmonella* is a facultative anaerobic gram-negative rod with the family of *Enterobacteriaceae* having flagella except for *Salmonella Pullorum* and *Salmonella Gallinarum* which lack flagella for mobility [42]. Epidemiological patterns of infection prevalence and incidences of disease differ greatly between geographical areas depending on climate, population density, farming practices, food harvesting and processing technologies and consumer habits. Salmonellosis is the most prevalent disease in intensive animal husbandry, especially in poultry and swine production [43]. The control mechanism of salmonellosis is based on reducing the risk of exposure to infection by implementing a closed flock/herd policy, purchasing animals from a reliable source and preventing contamination of food staff and water sources [44].

The severity and clinical manifestation of salmonellosis infection in small ruminants differ by age group and serotype [45]. Acute enteric salmonellosis is common in adult sheep leading to fever, anorexia, depression, and diarrhea, while septicemia is more common in young animals [46,47]. However, asymptomatic carriage, gastro-enteritis, and abortion also described [47]. The late-term abortion, mortality in ewes and high calf mortality can lead to extensive economic losses in sheep production, making salmonella abortion one of the most economically important diseases of small ruminants [48]. Abortion problem due to infection with serotypes such as *Typhimurium* or *Dublin* has been reported but abortion is most frequently caused by *salmonella abortus ovis*, an ovine adapted serotype that also occasionally infects goats and abortion generally occur in the last weeks before parturition [45,49]. Infections of ewes with serotype *abortus ovis* can also lead to stillbirth, metritis, placental retention, or peritonitis, and infected ewes may present with fever, anorexia, and depression before an abortion [47].

The high prevalence of nontyphoidal salmonella isolates 6.19% from sheep and goats feces in eastern Hararghe of Yifa Bate and Bacheke Pas was reported by [42]. Another author [50] isolated 3.3% salmonella from sheep feces in Jimma, [51] and [52] reported 2.1% and 4.8% isolated in the fecal samples of apparently healthy slaughtered sheep in Deberzeit abattoirs and from sheep and goats in central Ethiopia respectively and [53] isolated 1.04% salmonella from apparently healthy slaughtered sheep and goats in Addis Ababa abattoir enterprise.

Q fever: *Coxiella burnetii* is intracellular; a gram-negative bacterium that causes Q fever in humans and coxiellosis in animals. The organisms are ubiquitous in the environment where it can persist in a spore-form for years [54]. Cattle, sheep, and goats are the most clinically affected by the infection. They are often implicated as the source for infection for humans [55]. The chronic infection by *Coxiella burnetii* causes abortion, stillbirth and dead or weak offspring in sheep and goats [56].

Coxiella burnetii infection has been documented in a broad range of animals including almost all animals worldwide the animals get the infection from direct contact with infected animals, contaminated environments and inhalation of aerosolized organisms [57]. Animal birth products (placenta, fetuses and amniotic fluid), animal excrete and milk is the most likely sources of infection [55]. This is because the spore-like form of the bacterium can survive for years in the environment and travel long distances as aerosol and dry wind conditions may contribute to animal exposure and disease transmission. The organisms have also been found in ticks, which may also serve as a source of infection for animals [58]. *Coxiella burnetii* has been detected in the faces, milk, urine, vaginal discharge, semen, and birth products of animals. Irrespective of species, the highest numbers of organisms are shedding in conjunction with an adverse pregnancy event like abortion, stillbirth and neonatal weakness [56].

Animal infection is occurring mainly through exposure to a contaminated environment. The ubiquitous nature of *Coxiella burnetii* are persistence in the environment, complete eradication of the bacteria from an infected farm would be nearly impossible. Though, transmission can be reduced with good hygiene and other management practices that reduce environmental load, such as immediately removing and disposing of aborted foetuses, dead new-born and placentas [59].

In Ethiopia, the existence of an antibody against *Coxiella burnetii* was reported in sheep and goats slaughtered at Addis Ababa abattoir. The seroprevalence of 6.5% was also reported in Addis Ababa abattoir workers. Another study also reported 31.6%, 90% and 54.2% seroprevalence of Coxiellosis in cattle, camels, and goats in southeastern Ethiopia [60].

Status of small ruminant abortion in Ethiopia

In different tropical countries livestock, health and reproduction complications are high due to environmental factors like high temperature and humidity, a geographical structure which easy to soil-borne disease multiplication, drought, and stress factors are common in these areas. As a result of the above conditions in these areas feed availability is limited and low vegetation coverage were seen. The other major reason is the lack of strong animal health services [61]. Husbandry systems, variations in livestock breed and environmental conditions greatly influence the spread of the cause of abortion [62]. Thus, the prevalence of abortion is varying in a different production system, livestock breed and agro-ecological zones [63].

Studies on major health and reproductive problems of sheep and goats in different parts of the country showed that there is an abortion problem in small ruminants. The study conducted by [64] indicated that a 0.13% prevalence of abortion was recorded in goats of the Daro Labu district in Eastern Ethiopia. Another study conducted using

observational study in this area also indicated that 25.4% and 22.7% prevalence of abortion was recorded in goats and sheep, respectively [64]. Additionally, a study conducted by [65] showed that 82.9% of small ruminants were affected by abortion based on a questionnaire survey in Northern Ethiopia.

CONCLUSIONS

Despite the enormous contribution of a small ruminant to the daily life and livelihoods of the community, their productivity is constrained by abortion. The existing study indicated that there are many causes of abortion in Ethiopia including infectious disease and non-infectious conditions and there is the information gap on disease dynamics, distribution and proportion of natural host which was not studied exhaustively. Different studies indicated that the major risk factors for small ruminant abortion are age, parity, genetics, environmental, geographical factors, infectious agent factors, and herd size in the different production systems. The existing situation of abortion in Ethiopia calls coordinated all stockholder epidemiological surveillance which is urgently required together with keeping of the causative agent. This information would be helpful to improve the farmers' livelihood and may open new opportunities for research for the eradication and control of the causative agents of abortion in small ruminants. Therefore, characterization and isolation in coordination with all stockholder epidemiological surveillance are required to quantify the magnitude and extent of economic loss on sheep and goat production systems.

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