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Theileriosis

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(فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ ۗ
وَلَا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ يُقْضَىٰ إِلَيْكَ
وَحْيُهُ ۖ وَقُلْ رَبِّ زِدْنِي عِلْمًا)

صدق الله العظيم
(سورة طه- الاية: 114)

Abstract

Theileriosis are Tick-borne protozoan diseases associated with *Theileria spp*. in sheep, goats and horses as well as in wild and domestic mammals. However, very little of theileriosis is documented in camels . Theileriases are a group of tickborne diseases caused by Theileria spp. A large number of *Theileria* spp are found in domestic and wild animals in tick-infested areas of the Old World. The most important species affecting cattle are *T parva* and *T annulata*, which cause widespread death in tropical and subtropical areas of the Old World. *T lestoquardi* and *T luwenshuni,* are important causes of mortality in sheep.

The Theileria species infect a wide range of both domestic and wild animals and are transmitted by ixodid ticks of the genera Amblyomma, Haemaphysalis, Hyalomma and Rhipicephalus. Most of these ticks are renowned for the large economic losses they cause to the agricultural industry due to disease outbreaks, mortalities, damage to hides and poor production in domestic animals

There are several methods for diagnosed *Theileria* infection, including the clinical finding, Microscopical, Serological, Molecular methods, as well as postmortem examination

Introduction

Theileria parasite is one of the most common tick-borne diseases, which have reported in a wide range of ruminants such as sheep, cattle and goats, but only a few literatures were distributed in camels (El-Fayoumy *et al*, 2005 and Youssef *et al,* 2015). In animal Theileriosis is protozoal disease caused by blood parasites belonging of the genus *Theileria* (Demessie and Derso, 2015). The parasite is recognized by separate group of special organelles known as apical complexes (Bishop *et al*.,2004).

Theileria are tick-transmitted, obligate intracellular parasite that are important pathogens of livestock in the tropical and subtropical regions of the world. (Dobbleare and Mckeever ,2002). *Hylomma dromedarii* ticks principal vector infested these camel, indicating a role in *T. camelensis* transmission, the parasite has different developmental stages of various in forms and shapes inside this vector (Salimabadi *et al.*, 2010; Hamed *et al*.,2011). Generally, the life cycle of all *Theileria spp*. is similar (Shaw, 2002). It needed two host, vertebrate host and tick vector and it permit in two form erythrocyte and lymphatic (Bishop *et al*., 2004).

Theileriosis distribution is a determined by the incidence of tick vectors. Conseguently, there is a seasonal prevalence of the disease, which is modulated by its vectors' ecology (Bakor, 2008).

The main clinical finding of camels infected by *Theileria* are fever, sever emaciation, ocular discharge, diarrhea in the form of intermittent bouts, as well as systemic signs, enlargement of superficial lymph node (El-Fayoumy *et al*.,2005).

Diagnosis of *Theileria* infection in acute phase is based on clinical signs and microscopic detection of intraerythrocytic piroplasms and intralymphocytic schizogony in Giemsa stained blood and lymph node smears (Maharana *et al*, 2016). The serological examination includes the complementary fixation test

(CFT), the indirect fluorescent antibody technique (IFAT) and enzyme –linked immunosorbent assay (ELISA)are more accurate and capable of detecting the parasite antibodies (Rothschild ,2013). PCR test is more sensitive and specific than other diagnostic techniques (Mahmmod *et al*., 2010; Qablan *et al.*, 2013).

Understanding the pathogenesis and immunology of infectious diseases helps the policy markers to define control strategies (Singh *et al*.,2006; Tanwar *et al.*,2009). There fore, prevention of the disease by control programs to ticks seem necessary and prerequisite for improving meat and milk production (Nazifi *et al*.,2011; Hekmatimo-ghaddam *et al*.,2012).

Historical view

Koch in 1901,was the first who studied the outbreak of endemicdisease in south Africa which known later East Cost Fever ,he notedintra-lymphatic stage or called schizont which known for long timeKoch's blue bodies, then cited by Stephens and Christopher in (1903) weredescribed the causative parasite which known later piroplasm koch .After that, cited by Arnold Theiler in 1904 called the parasite *piroplasm parvum*which become accredit scientific name in references ,which graduallychange to *Theileria parvam* cited by Bettencourt in 1907 (Lainso,2007). Which gradually changes to *Theileria parvam* (Lainso,2007). *T. annulata* was reported as the first named *piroplasma annulatum* in Transcaucasian cattle in (1904). It had been reclassified as *Theileria annulata* after the schizont stage recognition in its life cycle (Weir ,2006).

It also appeared between 1912 and 1922 in Zambia, Malawi and Mozambique (Province of The Tete). Theileriosis continues to distribute in these countries and causes economic losses for livestock-oriented communities (Yusufmia *et al.*, 2010).

Cited by Yakimoff *et al*., (1917) the first provisionally identified *Theileria* infected camels in Russia, so far, two species of *Theileria* have been recorded in the world, *Theileria camelenesis* and *Theileria dromedarii* (Borji *et al*.,2009).

Cited by Machattie in 1935, was the first to waken to find the parasite in Iraq and observed that infected the calve with disease in (2-3) weeks of age and the mortality extended (50%). Essential parasites and infections in Iran and Iraq had been recorded to be common cited by (Hawa *et al*., 1981).

Taxonomy

Taxonomy of genus *Theileria* can be summarized, according to (Tarimo ,2013) as follows.

Kingdom: Protista
Sub kingdom: protozoa
Phylum: Apicomplexa
Class: sporozoea
Subclass: piroplasmia
Order: piroplasmoirda
Family: Theileriidae
Genus: *Theileria*
Species: *T. annulata*
T. lestoquardi
T. camelensis

Morphology

There are different development stage of various shapes and forms of *Theileria species*, that infected baffuloes, cattle, sheep, goats, as well as camels were in the shape of slender spine –like form an elongated structure or round form measuring (3.75) μm in diameter and ring in shape, and surrounding centrally located nucleus with a cloud-like spread cystoplasm (Hamed *et al*.,2011). The are two form of *Theileria* parasite :

1- Erythrocytic form

Theileria parasite is small 0.5-2 μm in size found in red blood cells and shows a blue cytoplasm with a red chromatin granule at one end with Giemsa stain, while it stained with Romanowsky stain it's observed nucleus has dark red

stained and cytoplasm light blue, there is no evidence of parasite replication within erythrocyte cells, piroplasm in red blood cells is non- dividing shape and the end shape of in vertebrate host infection, the parasite takes several form inside RBCs similar to ring, round, oval, and comma in shape, the rode is dominant shape (Coles, 2000). In camel observed ring and rod form of *Theileria spp*. (Nassar, 1992; Youssef *et al.*, 2015). The erythrocytic form of *T. camelensis* were rod, rounded, and ring in shaped (Hamed *et al*., 2011). Figure (1).

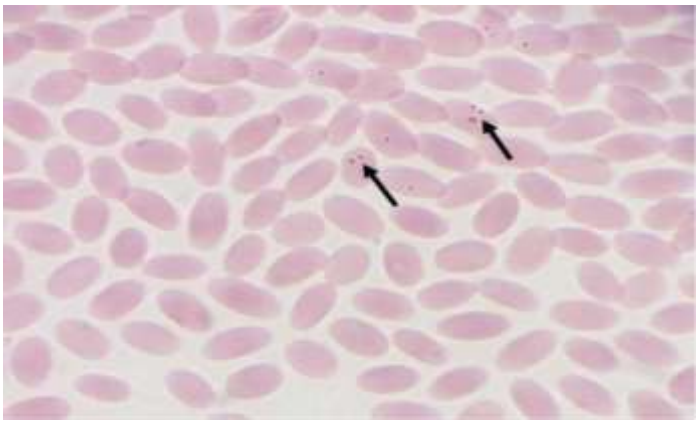

Figure 2-1: Blood smear intraerythrocytic pleomorphic of *Theileria piroplasms* (arrows) (Giemsa stain, 100×) (Abdelwahab *et al*.,2019).

.2- Lymphatic form

The parasite found in lymph node known as (Koch's blue bodies) it is representing the parasite schizont and occurring in two forms macroschizont type consisting of (8-12) nuclei and microschizont consisting of (50-100) nuclei (Telford *et al*.,2002; Shaw, 2003 and Mans *et al*.,2015). That contain small granules of chromatin and generate micromerozoite (Soun,2002).

Multiplication primarily in the lymphocyte cytoplasm and rarely in endothelial cells of lymphatic gland and spleen, proliferation microschizonts within the lymphocyte and produced inflammatory reaction in lymph node infected with disease (Jabbar *et al.*, 2008). Examination of smears prepared from lymph nodes, lung, liver, kidney spleen, and peripheral blood noticed which

microschizonts and macroschizonts could be present in all these samples, but microschizonts were the dominant form while macroschizonts were rarely seen (Yin *et al*., 2003). Figure (2).

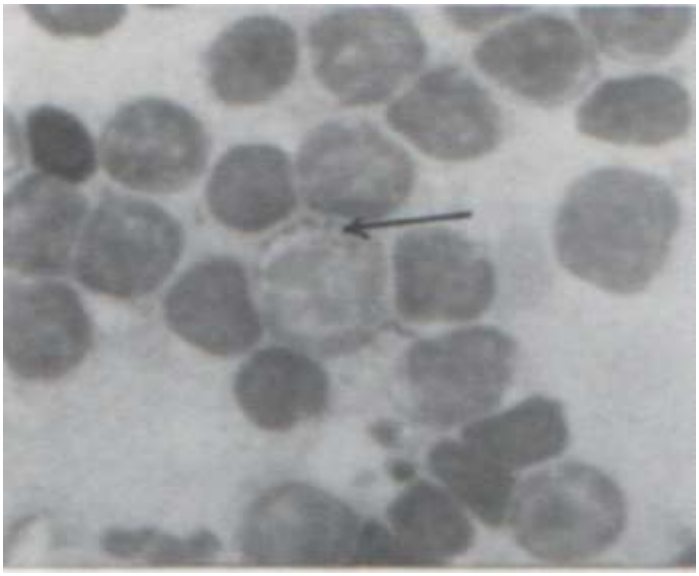

Figure 2.2: Smears of lymph node from camel observing lymphocytes infected by schizonts (1250x) (El-Refaii *et al.*,1998).

Life cycle

Life cycle of *Theileria* parasite is a complex and active in nature (Mans *et al*., 2015). It has a general apicomplexan with many differentiation steps, distributed with vertebrate hosts and vector tick of proliferation phases. (Mckeever,2009 and Mans *et al*.,2015).

The parasite has a life cycle of least, three stages: asexual reproduction in the vertebrate host through schizogony and merogony followed in the tick vector by sexual reproduction and sporogony (Tait andHall,1990).

Theileria sporozoites invade their vertebrate host during tick feeding and quickly reach mononuclear leukocytes, where they transformed into macroschizonts and induce multiplication to host cells (Shahnawaz *et al.*,2011).

Macroschizont mature further into microschiznts and finally form uninucleated merozoites through merogony released into blood stream, further development and multipication of merozoites presents Within RBCs forming piroplasm. This stage is non influence to tick, and causes the disease (Qayyum *et al*.,2010).

A typical life cycle for the genus *Theileria* involves sporozoite secretion During tick suckling into the feeding site, sporozoites then invade leukocytes and proliferate via merogony, after that merozoites are released that enter RBCs and form the piroplasm stage, during the next life cycle feeding, larval or nymph tick vectors ingested piroplasms and liberate parasite undergo tick gut syngamy, forming a zygote, the only stage of the diploid, the zygote divisions into motile kinetes which infect gut epithelial cells of the tick and transfer to the haemolymph and then infect the salivary glands, following tick feeding and initiation, sporogony results in the proliferation of sporozoites in salivary gland acini by nymphs or adult ticks before inoculation at the feeding site (Mckeever, 2009; Man *et al*., 2015). Figure (3).

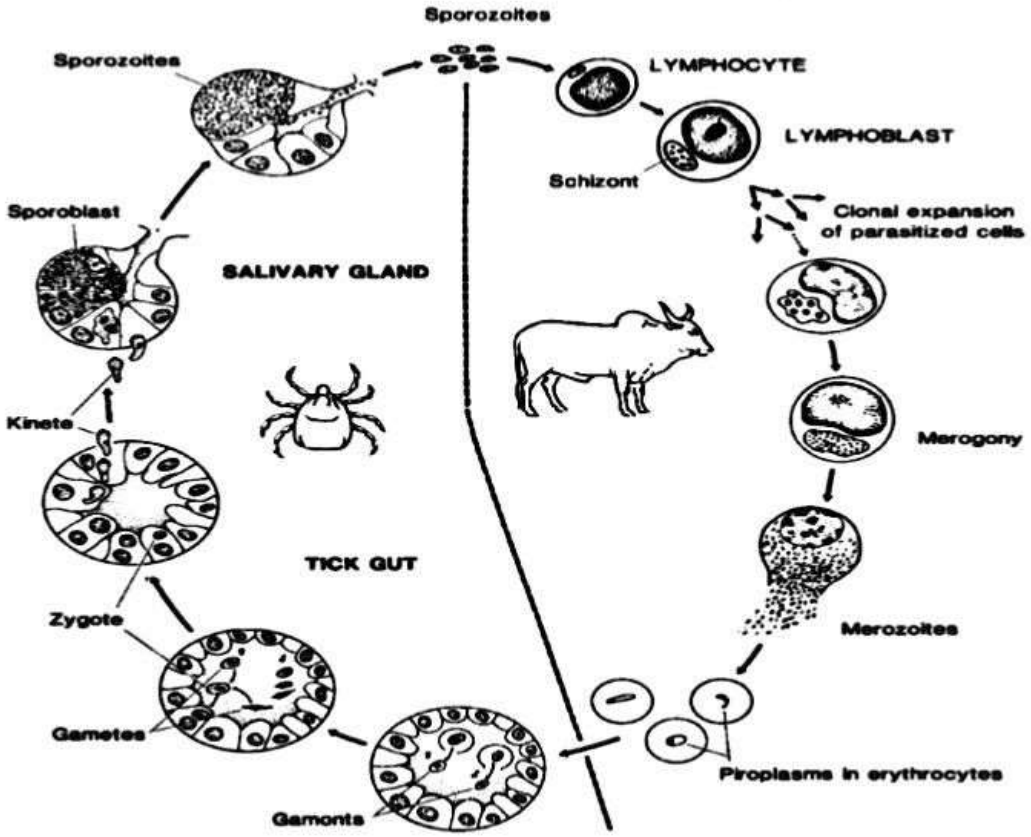

Figure 3: The life cycle of *Theileria* (Bishop *et al*., 2004).

Epidemiology

The parasite and vector spread, risk factors, mortality and morbidity disease outbreaks and host range including host tolerance and susceptibility are included in *Theileria* epidemiology (Gachohi *et al*.,2012). The occurrence of Theileriosis depends on the geographical area and several other variables, such as tick distribution, age, environment factor, management practices, gender and immunity, either passive or active (Magona *et al*., 2011).

The geographical prevalence of theileriosis is determined primarily by the biology and location of the genus *Hylomma* vector (Pieszko., 2015). With regard to age and sex sensitivity to disease, several studies have shown no statistical effects between sex, age and infection with *Theileria* (Razmi and Yaghfoori, 2013). The sex of ticks has been recorded to play a major role in the transmission, prevalence and severity of the infection. (Sayin *et al.*,2003).

Climate circumstances determine the dynamics of tick-borne infection by influencing the prevalence of ticks and seasonal frequency (Ahmed *et al*.,2007). Local breed demonstrated less or no disease signs compared with exotic breed (Yokoyama *et al.*,2011). Morbidity and mortality are different depending on the susceptibility of the host and the strain of parasite (OIE, 2004). Mortality differs considerably, being (10%) in some regions and up to (90%) in others regions(Soulsby,1982).

Mode of transmission

Theileria species is transmitted by trans-stadial transmission only from the tick stage to the stage, due to ticks are often present in large numbers on camel (Mckeever ,2009 Hamed *et al*.,2011 and Alim *et al*.,2012). Ticks belonging to the Ixodidae family hard tick transmit a widespread of pathogens to vertebrates extending from viruses to helminths, *Theileia* infection is one of the wide varieties transmitted by ticks (Gosh *et al*. ,2007). These are three ticks host as nymph, larvae and adult may not essentially feed on the same host, the infection acquire nymph and larval instars of tick through blood meal and before molting leave the host to the next stage, responsible for further transmission of infection are both nymph and larvae by attaching to the new host. (Zajac *et al*., 2006; Gul *et al*.,2015). The tick becomes infected when a larva is fed or nymph, and parasite is transferred to the tick's next development stage (Abdigoudarzi,2013). Adults are more vector effective than nymphs (Radosites *et al.*, 2007).

The genus *Hyalomma* of tick is vector of *T. annulata* (Saeed *et al.*, 2016; Hassan *et al*.,2017). Suitable with ticks for survival and questing behaviors.

Thinner and shorter hair skin is usually preferred by tick for infestation, because mouth parts may easily penetrate the vascular regions for feeding. (Sajid, 2007). Ticks may maintain infected with the pasture for up to 2 years

depending on the weather, diseases are not preserved in the absence vectors of these field (OIE, 2009). Also via vertical transmission (Zakian *et al*.,2014).

pathogenesis

The pathogenesis of *Theileria spp*. can be divided into "transforming" schizontal organisms and "non-transforming." the non-transforming *Theileria* is considered to be infectious as a result of piroplasm-induced anaemia. (sivakumar *et al*.,2014).

The severity of the disease depends on the virulence, causative strain, host's health, age, infection quantity and susceptibility status (preston *et al*., 1992; Bakor, 2008). Pathogenesis of numerous forms Theileriosis depends on the manufacture of lymphocyte schizonts and piroplasms in RBCs (Radostites *et al*.,2007). The parasite reproduces severe lymphocytopenia, jaundice and anemia in both lymphocyte and erythrocyte form (Norval *et al*., 1992). *T. camelensis* produces various schizonts and piroplasms and all infected camels noticed a clinical feature that could indicate the high pathogenicity (Ismeal *et al*.,2014). In other *Theileria species, T. annulata*, *T. hirci*, *T. parva,* are highly pathogenic and develop numerous schizonts and piroplasms; *T. mutans, T. ovis T. buffeli*, rarely product schizonts but can cause different degrees of anaemia in RBCs when there is a large number of piroplasms. (Radostits *et al*., 2008). As to the infection *Theileria annulata,* the schizonts are considered to be the most pathogenic parasite stage and therefore cells infected with this species express high levels of mRNA for cytokines, in particular IFN-y (Preston *et al*., 1993; Ahmed *et al*., 2008).

Theileriosis caused by macroschizont and affects the lymphocytes and reticular-endothelial disease, the clinical findings and severity of the infection are clrosely linked to the degree of leukopenia arrested from the maturation of these cells in the bone marrow due to the toxic effect of the parasite and increase the number of lymphocytes infested. (Von Schubert *et al*.,2010; Ismael *et al*.,2014).

The pathogenesis of lymphopenia and eosinophilia were described indicative of the lymphadenopathies influenced by the parasite *Theileria* which initially proliferates in lymphocytopenia in the lymphoid tissue (Morrison,2015; Abdelwahab *et al.*,2019).

According to *T. annulata* had both a lymphoproliferative and lymphod-destructive phase and a haemolytic stage (Soulsby, 1982). Hemolytic anemia is characteristic of tropical Theileriosis (Omer *et al.*, 2002). Anemia was observed in camels suffering from Theileriosis with a substantially higher MCV value for infected camels as well as increase number of immature red blood cells in response to anemia and a higher MCHC value in infected camels due to RBCs lyses (Mahran, 2004; Jalailudeen *et al.*, 2011 and Osman *et al.*, 2015).

Oxidized RBCs to may be damage by erythrophagocytosis and oxygen radicals also may be including in anemia pathogenesis (Razavi *et al*., 2012). The infected erythrocytes indicate morphological disorders that can be linked to the involvement of schizonts of *Theileria* immune mediated complexes and intravascular thrombi (Singh *et al.*, 2001).

Clinical signs

The period of incubation differs from (4-14) days after the infected ticks are attached to the host (Boulter and hall,2000). The disease may last as little as (3-4) days in acute form or may persist for approximately 20 days (Soulsby,1982). The incidence of the disease differs depending on the parasite species, the sensitivity of the host is also the number of sporozoite inoculated and the severity of the infection is directly relative to the initial inoculum injected by sporozoites (Boulter and hall,2000; Bakor.,2008). The course of infection may differ from per acute, acute, subacute to chronic determined by the relationship between the parasite and the host (Graham *et al*.,2006).

The predominant clinical signs in camels infected by *Theileria* were fever, severe emaciation, ocular discharge, intermittent bouts of diarrhea as well as

the systemic signs, enlargement of superficial lymph node, (El-Fayoumy *et al*.,2005; Hamed *etal*.,2011). abortion, infertility, rapid loss of condition, anorexia (Ismeal *etal*.,2014). It was stated that the camels were infected with *T. camelensis,* pale mucous membrane, weakness of the hind limbs, heart and breathing rates, and ruminal contraction, according to (Al. Saad *et al*., 2006).

Infection with *T. annulata* (Tropical Theileriosis) is characterized by high temperature increase, enlarged lymph nodes, excessive appetite, weight loss, conjunctival petechial, fatigue, diarrhea, and dysentery. are also related with later stages of disease (Radostits *et al* ,2007 and Muhanguzi *et al*.,2014).

Animals infected with the pre-acute form of the disease can die within (3-4) days of the first symptom, in chronic form, clear emaciation, irregular fever, icterus and anemia, may continue for (1-2) months before animal recovery (Levine, 1985).

Sometimes the parasites may invade the CNS leading to a fatal condition called "turning sickness" and paralysis, which is associated with the blockage of the brain capillaries by infected cells and leads to neurological signs (Rocchi *et al*., 2006). Pyrexia, leucopenia, edema of throat, salivation, rough body coat the clinical manifested of disease (Naz *et al*.,2012).

Diagnosis

The diagnosis of Theileriosis includes clinical finding, postmortem observations, distribution of vectors (Taylor *et al*.,2007). The identification of *Theileria spp*. by use of microscopic, serological, and molecular methods (Liu *et al*., 2010).

1. Microscopic method

The microscopic examination of the parasite based on Giemsa stained blood and lymph node biopsy smears, where parasites occur basophilic inclusions in the erythrocytes as round, comma, oval, pyriform, or rod-shaped

(Taylor *et al*., 2007). The light microscopy was used to limit the presence of blood parasites during the acute phase of the Theileriosis, thus giving the best result (Chaudhri and Gupta, 2003). One of the main characteristics of Theileriosis is that once the animal has recovered from the primary disease, it will become a carrier for a long time, the animal has very low parasitemia, at this stage which is difficult to detect by microscope. (Junlong *et al*.,2015).

Most of the Piroplasms in *Theileria spp*. can remain in recovered animals for months or years, and may be intermittently observed in subsequent tests, but negative results from microscopic blood film inspection do not preclude latent infection (OIE, 2004).

2. Histopathological diagnosis

The schizont is a characteristic diagnostic feature of acute infections with *T. parva* and *T. annulata* in Giemsa's stained biopsy or tissue impression smears of lymph nodes, liver and spleen, the schizontis the pathogenic stage of *T. parva* and *T. annulata*, it initially causes alymphoproliferative, and later a lymphodestructive disease, the piroplasms of *T. parva*, *T. annulata* and *T. mutans* are similar, but thoseof *T. annulata* and *T. mutans* are generally large and may be seen to divide, Schizonts are scarce in the peripheral blood of acutely sickanimals, the gross pathology caused by schizonts of *T. annulata* resembles that of *T. parva*, while anaemia and jaundice are features of the piroplasm pathology (OIE, 2004). The gross pathology caused by *T. annulata* is also of value in clinical diagnosis. Parasitized cells may be found in impression smears from all tissues (Forsyth *et al*., 1999).

3. Serological method

Subclinical infections may be identified in epidemiological studies using serological tests such as conglutination, IFAT (Immunofluorescent antibody test), ELISA (Enzyme-linked immunosorbent assay), CA (capillary tube

agglutination), and IHA (Indirect hemagglutination assay), serological methods include the determination of antibodies produced against foreign attackers that cause infection (Molad *et al*., 2006). Serological diagnosis of camel Theileriosis based on indirect fluorescent antibody test (IFAT) or enzyme-linked immuno sorbent assay (ELISA) detecting the circulating antibodies against piroplasms or macroschizonts. (D'oliveira *et al*., 1995).

The Indirect Fluorescent Antibody Test (IFAT) was developed based on schizonts or piroplasma antigen to detect the circulating antibodies against *Theileria* (Salih *et al*., 2003; Taha *et al*.,2003).

Consequently, the ELISA method was developed using whole lysate parasite or different antigens isolated by monoclonal antibodies (Katende *et al*., 1990). ELISA provides greater sensitivity and specificity than IFA testing (Morzaria *et al.*,1999 and Musoke *et al.*,1994). ELISA was initially developed into antibodies that are derived from piroplasma antigen, recombinant proteins were later used on the basis of TAMS1 surface molecules (Gubbels *et al*., 2000). ELISA focused on schizont antigen performed well when the cell fraction was enriched with a soluble fraction (Manuja *et al*.,2000).

Nevertheless, due to their limitation these approaches are also not accurate, cross-reactivity change, and may confront false positive negative results, when antibodies continue to disappear *Theileria piroplasm* may be present in RBCs of long term carriers, notwithstanding negative serological testing the animal may still be contaminated, precise documentation of carrier animals is important, as they can spread pathogens to non-endemic regions (Gul *et al*., 2015).

4. Molecular method

Theileria spp. can be distinguished by molecular methods. The tests are highly sensitive and specific to blood parasite DNA detection(Tarimo,2013).

Polymerase chain reaction (PCR) has largely replaced other methods and is widely used in veterinary parasitology as a species-specific molecular diagnostic assay to determine piroplasma –carrier animals, compared to conventional approaches, these are highly sensitive instruments used to diagnosis pathogens in carrier animals. however, contamination may lead to false positive results, mixed Infectious are also not always detected by PCR (Yusufmia *et al*.,2010).

This method is not only used to discriminate closely related species but also detects piroplasms of distinct species, it also indicates previously unrecognized species or new genotypes possibly present in sample (Nijhof *et al.,* 2005). Include polymerase chain reaction (PCR), random amplified polymorphic DNA(RAPD), loop- mediated isothermal amplification (LAMP), amplified fragment length polymorphism (AELP), restriction fragment length polymorphism (RELP) microsatellite marker process, luminex Xmap-based technology (areas of multianalyte), and the recently added real-time PCR (Blears *et al*., 2000; Guy *et al.*,2004; Parida *etal.*,2008; Quan *etal.*,2008). multiplex PCR (Al-hassan *et al*., 2005), Nested-PCR (Odongo *et al*., 2010), and reverse line bloat (RLB) hybrid-ization assay (Liu *et al*., 2016).

Treatment

Theileria is an intraerythrocytic parasite that is challenging to treat, and researchers have not yet noticed a drug therefore can eliminate infection, animal recovery is usually life- carrier, a number of theileriocidals, involving tetracyclines, buparvaquone and halofuginonelactate, have been used to treat this disease (Radostits *et al*.,2007).

Parvaquone (parvexon ND, Bimeda) is primarily active drug against schizont; the drug should be injected at a dose of 20mg / kg / I.M, buparvaquone is active against both piroplasms and schizonts; it should be injected at a dose of 2,5 mg / kg / I.M. The efficacy is estimated at 92 % after single injection, that is higher than parvaquone (Gharbi and Darghouth,2015).

T. parva and *T. annulata* have similar symptoms of the disease, including immune-depression and secondary bacterial infection, such as pneumomia and enteritis. Treatment with antibiotics is generally recommended to reduce this secondary infection (Minjauw and Mcleod, 2003; Gul *et al*.,2015).

The antibiotic tetracycline was probably the first chemotherapeutic compound to be used against ECF in (1953), The antibiotic is only successful at the early stages of infection and cannot be used at the later stages (Gachohi *et al*., 2012).

The use of combination of oxytetracycline (10 mg / kg B.W / I.M / five days) and buparvaquone (2.5 mg / kgB.W / I.M / once) indicates that absent parasites in blood smear have been collected from all animals after (7-10) days of treatment. (Taylor *et al.*, 2007; Radostits *et al* 2008 and Zia-ur-Rehman *et al.*, 2010).

In Iraq, Karawan, (2007) explain which the use of buparavaquone (2.5mg / kg) to repeat dose after the 48hrs was a very beneficial treatment for cattle Theileriosis.

Control

Good prevention of Theileriosis best achieved through a combination tick vector control and vaccination approach, although chemotherapy is the only alternative in clinical cases. However, there is a desperate need for improved control strategies based on the continuing prevalence of the disease in endemic countries, since drug resistance to Bw720 has been documented in vivo (Mhadhbi *et al.*,2010).

Acaricides are categorized into chemical groups that can be either organophosphate, carbamate, formamidine, or synthetic pyrethroid group. Such chemicals are used in dips, spray residues, or by hand spray. More recently, formulations " pour on ' or " spot on " were introduced (Gachohi *et al*.,2012).

The dipping process is considered the most powerful for the application of acaricides (Bakor ,2008). Biological control of ticks using carnivorous, bacteria, fungus, nematodes and viruses, (Samish *et al*.,2000). *Beauveria bassiana* and *Metarhizium anisopliae* that are essential fungi cause high ticks mortality (Kaaya, 2000). house mouse and Bee fiery red that are effective carnivorous to control ticks (Sutherst,2001).

In addition to biological control, including predators such as mice, birds and ants other alternative to control ticks have been ecological control, this strategy is used for environment and host related care, tick control in habitat and vegetation includes modification of the plant cover by removing the vegetation that shelters ticks (Nejash,2016).

Immunization by inducing infection and care, this method uses vaccination cattle against *T. annulata* by virulent *Theileria* that can cause mortality in animals by injecting the S/C parasite over the lymph node and, at the same time, giving the animal oxytetracycline (20mg / kg), this method quite successfully by inducing theileriosis and complete animal recovery (Morzaria, 1996; Pipano and Shkop, 2000).

Cell line vaccine immunoprophylaxis trials have been performed successfully in Iraq, Iran and Sudan (Ahmed *et al*.,2013).

Tick management practices should be adjusted to avoid tick borne diseases (Jirapattharasate *et al.,* 2016). Quarantine and animal testing in portals and carriers and emaciated animals slaughter (Gharbi *et al*.,2011).

A number of veterinarians have transfusions of blood on affected animals and have confirmed anecdotally improved survival of affected animals (Izzo *et al*., 2010).

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