



The Common Blood Parasitic Infections of Dromedaries *Camelus dromedaries: A Review*

Kamal M. Alsaad

Department of Internal & Preventive Medicine, College of Veterinary Medicine, University of Basrah, Iraq

Corresponding author: kamalsad58@yahoo.com

Received 16 August 2020; Accepted 26 October 2020; Available online 27 February 2021

Abstract: Since the old times, the camels are considered as an influential animal used in different purposes, like transportation and the production of a wool, milk, and meat. They can live and settle in different desert conditions all around the world. Blood parasitic infection of one-humped camels *Camelus dromedarius*, like Anaplasmosis, Babesiosis, Theileriosis, Trypanosomiasis and Mycoplasmosis, is more common as an infectious diseases transmitted mostly via arthropod ticks and some other ectoparasites. Increase body temperature, progressive haemolytic anaemia, digestive disorders, generalized weakness, and emaciation which might terminate by death are the main characteristics of those diseases, However, An epidemiological studies must always conducted to investigate the occurrence, incidence and the prevalence of those diseases around the world. It could be concluded that, The common blood parasitic infection of camels, could associated with loss of productivity among the affected individuals and might be a zoonotic risk for camel breeders, Clearly, it is of utmost importance to undergo periodical studies to track its prevalence in camels and contact people, The role of veterinary services is also important to advise farmers about the importance of those diseases and to maintain their animals free from ectoparasites by keeping the animals under hygienic conditions. Moreover, Further future programmed control measures will the best and final choice to eliminate these pathologies.

Key words: Blood Parasites, Dromedary camels, Middle east.

Introduction

It has been know that, the camels might inhabits with some of the most unsuitable living areas of the world, including, *Camelus bactrianus* the Bactrian type located in the upper deserts on Asia continent and the Dromedaries, (*Camelus dromedarius*) which located in the hot, dry deserts of the Middle East (Al-Ani, 2004). The dromedary camels (*Camelus dromedaries*) are anatomically and

physiologically can adapt to stay in difficult and different climate in the arid and harsh regions globally and are mainly living in definite parts of Arab deserts, African lands in addition to the western parts along to India (Wernery & Kaaden, 2002).

It was documented that, both Dromedaries and the Bactrian type of those animals are a good origin for production of milk, meat and

wool, as well as, they might also be considered as draught animals and could also use for transport in some countries around the world (Kamani, *et al.*, 2008).

Blood parasitic infections of one-humped camels (*Camelus dromedarius*), are more common as an infectious disease, endemic in various parts of the world, like, Anaplasmosis caused by *Anaplasma marginale*, Babesiosis caused by *Babesia caballi*, Theileriosis caused by *Theileria camelensis*, *T. dromedarii* and *T. equi*. Trypanosomiasis caused by *Trypanosoma evansi* and Mycoplasmosis caused by *Mycoplasma haemolamae* As, the susceptibility to the disease looked to be non-affected with the gender, age, and animal species, Moreover, the transmission of all those infectious agents took place via the insect bites especially the arthropod ticks including, *Hyalomma* spp., *Dermacentor* spp., *Rhipicephalus* spp. and *Haemaphysalis* spp. (Urquhart *et al.*, 2003; Abd-Elmaleck *et al.*, 2014; Qamar *et al.*, 2018).

Anaplasmosis, is considered an important infectious, ticks transmitted disease of domesticated and wild animals caused by the genus *Anaplasma*. Increase body temperature, haemolytic anaemia, digestive disorders and generalized weakness are the pathognomonic manifestations of this disease (Constable *et al.*, 2017). This infection has a worldwide distributions and allocations, particularly in tropical as well as the subtropical regions. It has also been recorded in some temperate areas, the disease occurs sporadically or as outbreaks leading to substantial, significant economic losses (Al-Ani, 2004). In Iraq, The disease is a common occurrence with wide distribution especially in the northern part areas (Alsaad, 2009).

In Iraq, studies of anaplasmosis in camels are very limited and little information had been provided. Although, different reports (Ajayi *et al.*, 1984; Wernery & Kaaden, 2002; Al-Ani, 2004) have been referred for the anaplasmosis in dromedaries, but still this disease is a matter of importance for research scientists.

Diseased animals show clear clinical manifestations, of anorexia, pale mucus membranes, emaciation, diarrhea with passing of watery faecal materials and /or with dry faeces of constipation, Moreover, rough hair coat, lacrimation with discharging of serious ocular discharge, on the other hand some diseased camels might show signs of coughing, However, ticks were found on different body parts. Furthermore, *Anaplasma marginale* the causative Rickettsia appears as spherical granules near periphery of infected red cells (Alsaad, 2009, see Fig (1); Constable *et al.*, 2017).



Fig. (1): *Anaplasma marginale* inside red cells of camels blood (Alsaad, 2009).

In Dromedaries (*Camelus dromedarius*), **Babesiosis**, resulted mainly from infection *B. caballi*, As basically they infect horses, ponies, mules and donkeys (Kouam *et al.*, 2010; Swelum *et al.*, 2014; Alsaad *et al.*, 2015; Al-Obaidi *et al.*, 2016). As, the life cycles of *B. caballi* comprise the developmental phases in both the horses as a host and the tick as a

vector, The life cycles of the both protozoa have, sexual blood phase (The gametocytes), and an asexual phase (The merozoites), as well as the asexual infective phase (The sporozoites), (Solusby, 1982).

Piroplasmosis of camel is as well, a synonym refers to as Camel's Babesiosis, which is distributed globally, especially at the most tropical as well as the semitropical districts of the world (Egbe-Nwiyi, 1994). Moreover the causative protozoa, *B. caballi* was registered in Iraqi dromedaries (Jasim *et al.*, 2015) and also was reported from different places around the world such as, Egypt, Jordan, Iran and Sudan (Qablan *et al.*, 2012; Khamesipour *et al.*, 2015; Ibrahim *et al.*, 2017).

In general, camel's piroplasmosis is manifested by continuous fever, in appetite, progressive haemolytic anaemia, haemoglobinuria (with the passing of coffee like urine), and paleness and/ or icteric mucosa, gastro-intestinal disorders, Moreover, emaciation and death is the end stage of the disease (Qablan *et al.*, 2012). Furthermore, Alsaad *et al.* (2015) indicated that diseased dromedaries with Piroplasmosis had a significant change, belong to haematological and biochemical parameters. However, programs which could apply to the control planes were not commonly available (Constable *et al.*, 2017). The trophozoites of *B. caballi* were appeared oval and mostly elliptical, Whereas, The merozoites was looked like a pear shape and particularly seen in pairs located inside the red blood cells (Fig. 2).

Theileriosis, It, considered one of the most vandal and devastating parasites affecting ruminates globally, causing lethal infections in most diseased animals (Ismael *et al.*, 2014).

However, information concerning camel's theileriosis is very little.

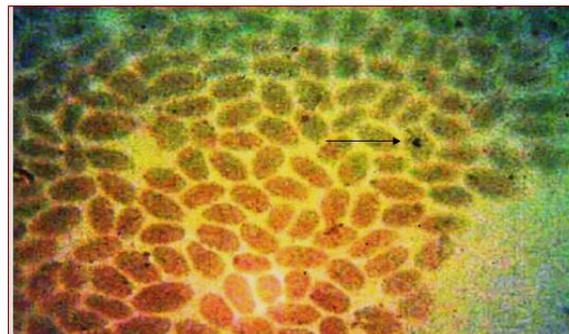


Fig.(2): *Babesia caballi* inside camel erythrocyte (Al-Saad *et al.*, 2015).

The most common *Theileria* spp. which are diagnosed in camels include *Theileria. dromedarii*, *T. camelensis* and *T. equi*, It also reported in different parts of the world, in Somalia, Egypt and Turkmenistan. Furthermore, The Koch blue bodies or the schizont does not obtain or noticed. Nevertheless, *T. dromedarii* which reported in India might be a non-pathogenic type (El-Fayoumy *et al.*, 2005). Moreover, the *Theileria* was diagnosed with the molecular technique in the camels of the Jordan (Qablan *et al.*, 2012).

Besides that, *T. ovis* which infect sheep and goats and the *Hyalomma* ticks were registered in camels in Egypt (Mazyad & Khalaf, 2002; Salimabadi *et al.*, 2010). Therefore, attempts for controlling the ectoparasites especially the ticks seems to be very helpful and valuable for the maintenance of the good meat and milk production of those animals (Constable *et al.*, 2017).

Camels theileriosis characterized by increase body temperature, emaciation, watery ocular lacrimation, intermittent severe diarrhea, in addition to enlargement of the superficial lymph nodes, particularly the cervical nodes of

the neck which, considered as the pathognomonic clinical sign (Ismael *et al.*, 2014). On the other hands, a haematological picture of diseased camels with theileriosis indicated progressive haemolytic anaemia with differentiation in clotting factor indices which could be considered as a good indicator in the differential diagnosis (Al-saad *et al.*, 2006, Fig. 3).

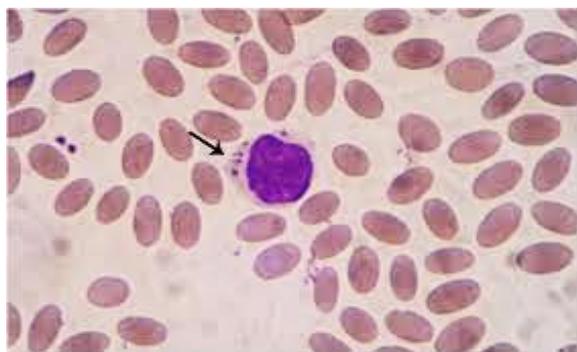


Fig. (3): Koch blue bodies (Schizont stage) of *Theileria camelensis* in camels blood (Al-Saad *et al.*, 2006)

Trypanosomiasis, is another important and very serious pathogenic blood parasitic infection of dromedaries caused by the protozoa *Trypanosoma evansi* which infected different domestic animal breeds at wide range areas, Moreover, trypanosomiasis, considered an important livestock disease in most areas of the world, causing a heavy economic loss in dromedaries (Abdel-Rady, 2008).

Surra, the disease of camels caused by the *T. evansi*, is one of the more serious protozoal diseases, manifested commonly with anaemia, loss of body weight, infertility; Furthermore, abortion in different stages of pregnancy was also indicated (Desquesnes *et al.*, 2013).

Trypanosomiasis, in camels causes major losses due to a decrease in production of meat and milk as well as the losses of abortions and a

birth of weak neonates (Abdel-Rady, 2008; Constable *et al.*, 2017)

The common clinical manifestations showed by diseased camels are anorexia with high body temperature and marked generalized edema, Further, the chronic type of trypanosomiasis is more prominent and manifested with marked muscular atrophy, undulant type of fever, paleness of mucous membranes, graduated loss of body weight and ascites. Diseased dromedaries might exhibit a diagnostic characteristic odour of urinary ketones (Constable *et al.*, 2017). The use of curative and prophylactic drugs like, the trypanocidal drugs is the best way to control it, however, the recommended treatment and strategies for chemotherapeutic control will always depend on the information of prevalence and incidence of the disease (Kamani *et al.*, 2008).

The morphological features of *T. evansi*, in camel's blood, revealed a large size parasite (25-35 μ m), with tiny sub terminal kinetoplast, and fine posterior end; however, a central nucleus, great undulate membrane, and the flagellum will also detect (Desquesnes *et al.*, 2013, see Fig. 4).



Fig. (4): *Trypanosome evansi* in camel blood (Al-Ani, 2004).

Haemotropic Mycoplasmosis, is an infectious disease caused by *Mycoplasma* spp, (Constable

et al., 2017). The organism thought to be rickettsial parasites (formerly classified as *Eperythrozoon*) causes an infectious anaemia in different mammalian species and their effects might terminate with severe weakness, apathy, and death (Fard *et al.*, 2014). The disease is always manifested by fever, anorexia, anaemia, lethargy, rough coat, decreased milk production in lactating animals, enlargement of superficial lymph nodes, and weight loss.

The disease is highly prevalent in different parts of the world. Since it was detected in Africa, southern Europe, central Asia, and some others places (Almy *et al.*, 2006). Moreover, it was also distributed in most regions of Iraq (Jarad & Alsaad, 2016). However, the disease had great economic importance of livestock production due to the high morbidities and mortalities, besides its considered as a zoonotic type.

Mycoplasma haemolamae was detected by Giemsa stained blood smears as the organism appears with different shape such as coccoid or rod, furthermore, it might found individually or it is arranged in chains, and infect the erythrocyte cell wall. In addition, the molecular method, PCR test was used to confirm the diagnosis (Fig: 5).



Fig. (5): *Mycoplasma haemolamae* (Almy *et al.*, 2006).

In General The paleness of mucus membranes showed by diseased camels indicates the development of anaemia of haemolytic type, Moreover, a significant reduction of erythrocytes and haemoglobin concentration will indicate because of the clear lysis of red blood cells and terminated with mechanical removal by the reticulo-endothelial system (Maharan, 2004). Furthermore, Transmitted ectoparasites particularly ticks invade various areas of diseased bodies in dromedary considered them as an important biological transmitter of the diseases (Wernery & Kaaden, 2002; Constable *et al.*, 2017). The so-called higher body systemic reactions indicated in diseased camels were observed to change, As, the detected of high fever, might suggest the liberation of especial chemicals called The pyrogens caused by body cell lysis which is commonly followed by the stimulation of hypothalamus for fever crises. Moreover, the anaemia will decrease perfusion of the blood. Therefore, tissue hypoxia and low oxygen level will follow, which result in the anaerobic type of metabolism with lowering perfusion, and by this, respiration will be raised (Kamani, *et al.*, 2008; Ismael *et al.*, 2014). The heart rate of diseased animals will accelerate, which is reflected from anaemic hypoxia caused by the erythrocytopenia and haemoglobin deficiency that affects the oxygen arrival to different tissues of the body, causing a lake of enough oxygen supply (Constable *et al.*, 2017).

Anaemia resulted from camels hemiparasitic infection will occur due to different mechanisms, the decrease erythrocyte lifespan due to destruction resulted from the direct action of the parasite and the lower activity of bone marrow (Abd-Elmaleck *et al.*, 2014; Swelum *et al.*, 2014). Moreover, anaemia in

infected camels with blood parasites is due to extensive phagocytosis of infected erythrocytes initiated by parasitic damage to erythrocytes and the antierythrocytic auto antibodies changes in bone marrow are an indication to bone marrow depression (Qablan *et al.*, 2012; Ismael *et al.*, 2014).

Leukocytosis which is always indicated by lymphocytosis, was developed due to the lymphoid stimulation and the activation of stem cells in the bone marrow by the causative parasite itself or by the parasite toxins, Nevertheless leukocytosis might also occur as a result to lymphoid depletion and disorganization with massive lymphocytes (Weiss & Wardrop, 2010).

Furthermore, lymphocytosis which is resulting at most of the times was marked during the formation of antibodies in response to antigen during infection (Al-saad *et al.*, 2006; Ismael *et al.*, 2014).

Conclusions

It has been concluded that blood parasitic infection of dromedaries has a clear diverse and adverse effect on diseased camels which might terminate most of the time in death Therefore, the following of the preventive animal vaccination programs is the safest way for all animals.

Acknowledgments

The author would like to thank the College of Veterinary Medicine, University of Basrah. Iraq.

<https://orcid.org/0000-0002-2871-6815>

References

Abd-Elmaleck, B. S., Abed, G. H., & Mandour, A. M. (2014). Some protozoan parasites infecting blood of

camels (*Camelus dromedarius*) at Assiut locality, Upper Egypt. *Journal of Bacteriology & Parasitology*, 5, 2-7. <https://doi.org/10.4172/2155-9597.1000184>.

Abdel-Rady, A. (2008). Epidemiological studies (parasitological, serological and molecular techniques) of *Trypanosoma evansi* infection in camels (*Camelus dromedarius*) in Egypt. *Veterinary World*, 1, 325-328. <https://doi.org/10.5455/vetworld.2008.325-328>.

Ajayi, S. A., Onyali, I. O., Oluigbo, F. O., & Ajayi, S. T. (1984). Serological evidence of exposure to *Anaplasma marginale* in Nigerian one-humped camels. *Veterinary Record*, 114, 478. <https://doi.org/10.1136/vr.114.19.478>

Al-Ani, F. K. (2004). *Camel Management and Disease*, 1st edition, Al-Sharq Printing Press. Dar-Amman Book Publisher, Amman, Jordan.77pp. <https://doi.org/10.15547/bjvm.2293>

Almy, F. S., Ladd, S. M., Sponenberg, D. P., Crisman, M. V., & Messick, J. B. (2006). *Mycoplasma haemolamae* infection in a 4-day-old cria: support for in utero transmission by use of a polymerase chain reaction assay. *Canadian Veterinary Journal* 47, 229-233. *PMCID: PMC1371050*

Al-Obaidi, Q. T., Mohd Mokhtar, A., Al- Sultan, I., Azlinda, A. B., & Mohd Azam. K. G. K. (2016). Equine piroplasmosis in Kelantan, Malaysia: Clinicohemato-biochemical alterations in subclinically and clinically infected equids. *Tropical Biomedicine*, 33, 619–631.

Alsaad, K. M. (2009). Clinical, hematological and biochemical studies of anaplasmosis in Arabian one-humped camels (*Camelus dromedaries*). *Journal of Animal And Veterinary Advances*, 8, 2106-2121. URL: <https://medwelljournals.com/abstract/?doi=javaa.2009.1794.1797>

Alsaad, K. M., Al-Amery, M. A., Al- Hamed T. A., & Muhsen R. K. (2015). *Babesiosis caballi* in one humped dromedaries of Basrah province. *Basrah Journal of Veterinary Research*, 14, 207-214.

Al-saad, K. M., Al-Obaidi, Q. T., Al-Obaidi, W. A. (2006). Clinical, hematoloical And biochemical study of Theileriosis In Arabian one humped Camles

- (*Camelus dromedarius*). *Iraqi Journal of Veterinary Science*, 20, 211-218. <https://www.researchgate.net/publication/329572902>
- Constable, P. D., Hinchcliff, K. W., Done, S. H., & Grünberg, W. (2017). *Veterinary Medicine: A Textbook of the Diseases of Cattle, horses, Sheep, Pigs and Goats*, 11th edition, Elsevier Health Sciences. 2278pp. <https://www.elsevier.com/books/veterinary-medicine/constable/978-0-7020-5246-0>
- Desquesnes, M., Holzmüller, P., Lai, D., Dargantes, A., Lun, Z., & Jittaplaong, S. (2013). *Trypanosoma evansi* and Surra: A review and perspectives on origin, history, distribution, taxonomy, morphology, hosts, and pathogenic effects. *BioMed Research International*, 2013, 194176. <https://doi.org/10.1155/2013/194176>
- Egbe-Nwiyi, T. N. (1994). Haematological and pathological studies of camel babesiosis in Nigeria. *Bulletin of Animal Health and Production*, 42, 287–290. <https://agris.fao.org/agris-search/search.do?recordID=US201301788201>
- El-Fayoumy, M. M., Abou Elnga, T. R., Abd El-Baky, S. M. M., & Abdou, T. A. (2005). Prevalence of camel theileriosis and its vector tick in North Coast of Egypt. *Journal of Egyptian Veterinary Medical Association*, 65, 291-302. <https://www.researchgate.net/publication/320919738>
- Fard, R. M. N., Vahedi, S. M., & Mohammadkhan, F. (2014). Haemotropic mycoplasmas (haemoplasmas): A review. *International Journal of Advanced Biological and Biomedical Research*, 2, 1484-1503. http://www.ijabbr.com/article_7347_ccce89525f8b3346857580626fcd8aca.pdf
- Ibrahim, A. M., Kadle, A. A. H., & Nyngilili, H. S. (2017). Microscopic and molecular detection of camel piroplasmosis in Gadarif State, Sudan. *Veterinary Medicine International* 1, 1-5. <https://doi.org/10.1155/2017/9345231>
- Ismael, A. B., Swelum, A. A., Khalaf, A. F., & Abouheif, M. A. (2014). Clinical, haematological and biochemical alterations associated with an outbreak of Theileriosis in Dromedaries (*Camelus dromedarius*) in Saudi Arabia. *Pakistan Veterinary Journal* 34, 209-213. www.pvj.com.pk. Corpus ID: 3417445
- Jarad, A., & Alsaad, K. M. (2016). Clinical, hematological and diagnostic studies of *Mycoplasma wenyonii* infection in cattle of Basrah Governorate. *Basrah Journal Of Veterinary Research*, 15, 37-53. <https://www.researchgate.net/publication/329988759>
- Jasim, H. J., Azzal, G. Y., & Othman, R. M. (2015). Conventional & molecular detection of *Babesia caballi* and *Theileria equi* parasites in infected camels in south of Iraq. *Basrah Journal Of Veterinary Research*, 14, 110-121. <https://www.researchgate.net/publication/311582910>
- Kamani, J., Usman, T. A., Onyemaechi, E. G., Usman, M. A., & Hussaini, H. A. (2008). Hemoparasites of camels (*Camelus dromedarius*) in Maiduguri, Nigeria. *Animal Research International*, 5, 838-839. <https://doi.org/10.4314/ari.v5i2.48726>
- Khamesipour, F., Doosti, A., Kooh, A., Chehelgerdi, M. I., Mokhtari-Farsani, A., & Chengula, A. A. (2015). Determination of the presence of *Babesia* DNA in blood samples of cattle, camel and sheep in Iran by PCR. *Archives of Biological Sciences*. 67, 83–90. <https://doi.org/10.2298/ABS140410009K>
- Kouam, M. K., Kantzoura, V., Gajadhar, A. A., Theis, J. H., Papadopoulos, E., & Theodoropoulos, G. (2010). Seroprevalence of equine piroplasms and host-related factors associated with infection in Greece. *Veterinary Parasitology*, 169, 273-278. <https://doi.org/10.1016/j.vetpar.2010.01.011>
- Maharan, O. M. (2004). Some studies on blood parasites in camels (*Camelus dromedarius*) at Shalatin city, Red Sea Governorate. *Assiut Veterinary Medical Journal*, 50, 172-183. Corpus ID: 92658230
- Mazyad, S. A., & Khalaf, S. A (2002). Studies on *Theileria* and *Babesia* infecting live and slaughtered animals in Al Arish and El Hasanah, North Sinai Governorate, Egypt. *Journal of the Egyptian Society of Parasitology*, 32, 601-610. PMID: 12214937
- Qablan, M. A., Sloboda, M., Jirku, M., Oborník, M., Dwairi, S., Amr, Z. S., Horín, P., Julius, L., & Modry, D. (2012). Quest for the piroplasms in camels: Identification of *Theileria equi* and *Babesia caballi* in Jordanian dromedaries by PCR. *Veterinary*

- Parasitology*, 86, 456-460.
<https://doi.org/10.1016/j.vetpar.2011.11.070>.
- Qamar, M. F., Ayaz, M. M., & Nazir, M. M. (2018). Isolation and identification of ectoparasites in single humped camels (*Camelus dromedarius*) of Cholistan area, Pakistan. *Iraqi Journal of Veterinary Sciences*, 32, 291-297.
<https://doi.org/10.33899/ijvs.2019.153866>
- Salimabadi, Y., Telmadarraiy, Z., Vatandoost, H., Chinikar, S., Oshaghi, M. A., Moradi, M., Mirabzadeh-Ardakan, E., Hekmati, S., & Nasiri, A. (2010). Hard ticks on domestic ruminants and their seasonal population dynamics in Yazd province, Iran. *Iranian Journal of Arthropod-Borne Diseases*, 4, 66-71. PMID: PMC3385546
- Solusby, E. J. L. (1982). *Helminth, arthropods and protozoa of domesticated animals*. 7th edition, Philadelphia, Bailliere Tindall, London, 809pp
[https://doi.org/10.1016/0035-9203\(84\)90110-X](https://doi.org/10.1016/0035-9203(84)90110-X)
- Swelum, A., Ismael, A. B., Khalaf, A. F., & Abouheif, M. A. (2014). Clinical and laboratory findings associated with naturally occurring babesiosis in dromedary camels. *Bulletin of the Veterinary Institute in Pulawy*, 58, 299-233.
DOI: <https://doi.org/10.2478/bvip-2014-0034>.
- Urquhart, G. M., Armour, J., Duncan, J. L., Dunn, A. M., Jennings, F. W. (Editor). (1995) *Veterinary Parasitology*. Blackwell, Oxford.
<https://doi.org/10.1111/vde.12367>
- Weiss, D. J., & Wardrop, K. J. (2010). *Schalm's Veterinary Hematology*, 6th edition, Wiley Blackwell, 1228pp
<https://www.vet-library.com/pathology/clinical-pathology/p-1418-schalm-s-veterinary-hematology-6th-edition.html>
- Wernery, U., & Kaaden, O. R. (2002). *Infectious Diseases in Camelids*. Blackwell, Vienna, 403pp.
<https://www.amazon.com/Infectious-Diseases-Camelids-Ulrich-Wernery/dp/3826333047>

الإصابات الشائعة بطفيليات الدم في الجمال احادية السنام: *Camelus dromedarius*: مراجعة بحثية

كمال مهلهل السعد

فرع الطب الباطني والوقائي، كلية الطب البيطري، جامعة البصرة، العراق

المستخلص: تعد الإبل ومنذ العصور القديمة حيوانات مهمة متعددة الأغراض، تم استخدامها للنقل وإنتاج الحليب والوبر واللحوم في المناطق القاحلة وشبه القاحلة من العالم. كما يعد الخمج بطفيليات الدم في الجمال احادية السنام من الامراض الشائعة والمهمة والتي تشمل الخمج بالانابلازموسز، البابيزيوسز، التايليريوسز، التريبانوسوميسز والمياكوبلازما الدموية والتي تنتقل في الغالب بوساطة القراد وبعض الحشرات الخارجية. تظهر الجمال المريضة علامات سريرية كارتفاع درجات حرارة الجسم، فقر الدم الانحلالي المتقدم، الاضطرابات الهضمية، الضعف العام والهزال والتي قد تنتهي في الغالب بموت الحيوان المصاب. يجب إجراء دراسات وبائية وبشكل مستمر للتحقق من حدوث هذه الأمراض وانتشارها في جميع أنحاء العالم. يمكن الاستنتاج أن الخمج بطفيليات الدم الشائعة للإبل يمكن أن تترافق مع فقدان الإنتاجية بين الحيوانات المصابة وقد تكون خطراً لمربي الإبل، وعليه وللأهمية يجب متابعة الدراسات الدورية لتتبع انتشارها في الإبل، فضلاً على ذلك فإن دور الخدمات البيطرية مهم أيضاً لإرشاد المزارعين حول أهمية الأمراض والحفاظ على حيواناتهم خالية من الطفيليات الخارجية عن طريق الحفاظ على الحيوانات في ظروف صحية. علاوة على ذلك، فإن المزيد من تدابير مكافحة المبرمجة المستقبلية ستكون الخيار الأفضل والأخير للقضاء على هذه الأمراض.

الكلمات المفتاحية: طفيليات الدم، الجمال احادية السنام، الشرق الاوسط.