



Study of Some Biochemical and Haematological Parameters in Blood of Stray Cats Infected with Ticks



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Abstract

IN THIS study and through examination of 64 naturally infested stray cats with ticks, the cats were randomly collected from different areas of Mosul city between October 2022 and June 2023. Two species of hard ticks were identified belonging to the genus *Rhipicephalus* species which are *R. sanguineus* and *R. turanicus*. Hematological parameters in the infested cats revealed a significant decrease in PCV, Hb, ESR, RBC and LYMPH which recorded 28.75, 8.75, 7.75, 3435000 and 9.5 respectively. ALP activity showed a very high significant increase and recorded 154 U/L; and a high significant increase in levels AST, LDH and CK activity which recorded 99.53U/L, 605.75U/L and 242.25U/L respectively compared with control groups which recorded 52.8U/L, 266U/L and 77.5 respectively; while ALT level activity showed a significant increase which recorded 41.03U/L compared with control group which recorded 29.4U/L. Significant increased AST, ALT and LDH are also accompanied by an increase in CK. Significant decrease level in Urea, Creatinine, TC and LDL concentration recorded 47.78mmol/L, 1.06µmol/L, 101mg/dL and 45.24 mg/dL compared with control group which recorded 57.76 mmol/L, 1.4µmol/L, 134.5 mg/dL and 65.2 mg/dL respectively. Troponin reported positive. TG and VLDL recorded significant decrease 127.9g/dL and 25.58mg/dL compared with control group which recorded 3.65g/dL, 165.5mg/dL and 33.10 mg/dL respectively. Results showed there are relationships for ALP, LDH and CK activity with a number of parameters measured in infested group in this study.

Keywords: Cat, Ticks, Hematology, Biochemical Parameters, LDH

Introduction

Hard tick is an obligatory blood feeding ectoparasite infecting mammals and birds. Ticks are large and long lived, feeding Periodically on large blood meals, with long intervals between meals. The genus *Rhipicephalus* belonging to the family Ixodidae are important because they infest a variety of mammals but rarely reptiles or birds. Most species of *Rhipicephalus* are three host ticks [1,2].

Rhipicephalus sanguineus known as brown dog tick with *Rhipicephalus turanicus* are both closely related species and widely distributed worldwide. They have been recorded in Europe, Asia and Africa [3,4]. Ticks bites may cause direct damages to their hosts, causing inflammation, irritation or even hypersensitivity and in heavy infestations they cause anaemia and production loss. The salivary secretions in some ticks cause paralysis and toxicosis; and more importantly, they are capable of transmitting a

number of pathogenic viral, bacterial, rickettsial and protozoal diseases when they attach and feed [1,5]. Both species *R. sanguineus* and *R. turanicus* have medical and veterinary significance because they are considered vectors of rickettsial diseases. *R. sanguineus* is the main vector of *Rickettsia conorii* and Q-fever as well as canine ehrlichiosis. *R. turanicus* is a vector of Q-fever [6,7].

During feeding, Ticks secrete saliva in the dermis, which contains biologically active substances that cause an allergic reaction. When the tick punctures the skin of its host, it injects a substance that anesthetizes the attachment site and reduces the blood coagulability; However, most dogs and cats with ectoparasites have no clinical symptoms; thus, animal does not reflect any discomfort and does not feel the tick's presence (8,9,10). The Ixodes affect animal health entirely such as severe blood loss, serious hematological changes, decrease of some blood biochemical parameters, mineral levels and

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trace elements [11]. Hematologic and blood biochemical studies are considered as one of the most vital parameters by which we can detect any disorder and infections in human and animals [12]. Our objectives in this research are to detect influences of these ectoparasites on hematological and biochemical parameters in infected cats.

Material and Methods

Sampling

A total of 64 trapped cats were randomly collected from different areas of Mosul city between October 2022 and June 2023 and catching them using food traps (baited cage - trap). The cats have not received veterinary care or exposed to insecticide were examined for ticks in the Department of Parasitology, College of Veterinary Medicine, University of Mosul. All methods of animal welfare laws are used for the hunted animals in accordance with local laws and regulations [13]. Ticks samples were collected by using forceps, and ticks were examined under the dissecting microscope and species of ticks were identified according to the morphological characteristics [1].

Single samples of blood about 5 ml were taken by a veterinary surgeon from all cats either from a cephalic or jugular veins. Blood samples were placed immediately into EDTA (ethylenediaminetetraacetic acid) while other part of blood samples collected for serum samples which collected from clotted blood after centrifugation at $1200 \times g$ for 10 min. Blood and serum, were stored at $4^\circ C$ until used [16].

Hematological examination

Hematology samples were prepared and analyzed by (Automatic full digital cell counter, Beckman USA) to obtain total RBC, Hb, packed PCV, and Westergren method used to get erythrocyte sedimentation rate (ESR) [15].

Biochemical examination

Blood serum samples were tested spectrophotometrically for the biochemical changes of alanine amino transferase (ALT), aspartate amino transferase (AST), Alkaline phosphatase (ALP), Lactate dehydrogenase (LDH), C-reactive protein (CRP), creatine kinase (CK), Urea, Creatinine, Uric Acid and Glucose were bounded using available kits of SYRBIO company.

Troponin, Total cholesterol (TC), Triglyceride (TG), High-density lipoprotein (HDL), and Very low density lipoprotein cholesterol (VLDL) measured by using available kits of RANDOX company. The Low-density lipoprotein (LDL) Estimated by Friedewald equation { $LDL = TC - (HDL + VLDL)$ } [16].

Total serum protein (T.P.), Albumin (Alb.), Globulin (Glob.), Globulin conc. was calculated according to

the equation (globulin conc. = total protein conc. – Albumin conc.) [17].

Statistical analysis

SPSS 22.0 was used to study data by using statistical analysis [18]. The means and standard errors for all data were presented. The correlation coefficient (r) was used to compare the relationship between activity of ALP, LDH and CK with other biochemical parameters in the infested group.

Results and Discussion

In this study and through examination of infested stray cats with ticks, it was found that there were two species of hard ticks belonging to the genus *Rhipicephalus* species which are *R. turanicus* and *R. sanguineus* according to the keys of morphological identification (Figure 1). The main hosts of *R. sanguineus* are dogs, but it parasitizes on many other animals as well as human. The species *R. turanicus* parasitizes a great variety of hosts like dog and human. *R. turanicus* and *R. sanguineus* ticks can be found on the same host, this correlates with [19]. Because of their morphological similarity, their identification has been rather problematic.

Effects of ticks on hematological parameters in the infested cats were compared with the control group, as shown in (Table 1), the results revealed a significant decrease in PCV, Hb, ESR, RBC and LYMPH which recorded 28.75 ± 1.12 , 8.75 ± 0.34 , 7.75 ± 1.39 , 3435000 ± 184458 and 9.5 ± 0.17 respectively; there is no significant increase in WBC parameters among infested cats group when compared with control. This is resulted from the feeding habits of ticks when they suck blood three times of their size, as with female *Amblyomma* that suck $1-2 \text{ mm}^3$ of concentrated blood and secretes enzymes from Coxal gland concentrated fat and protein in blood and expels water and minerals left by ticks at the sucking site of dermis; while the *Rhipicephalus* ticks secrete toxins within saliva substances causing decrease in the immunity system leading to anemia and weight loss (11,20,21 and 22).

Results in (Table 2) demonstrated ALP activity where it showed a very high significant increase in level at $P \leq 0.001$ and recorded 154 ± 8.5 U/L compared with control group which recorded 28.5 ± 2.5 U/L; and a high significant increase in levels AST, LDH and CK activity at $P \leq 0.01$ which recorded 99.53 ± 16.44 U/L, 605.75 ± 47.61 U/L and 242.25 ± 16.19 U/L respectively compared with control groups which recorded 52.8 ± 5.20 U/L, 266 ± 4.33 U/L and 77.5 ± 2.5 U/L respectively; while ALT level activity showed a significant increase at $P \leq 0.05$ which recorded 41.03 ± 4.52 U/L compared with control group which recorded 29.4 ± 3.27 U/L. Alkaline phosphatase elevation ALP is one of the most common biochemical abnormalities

documented in cats and dogs. ALT is located within the cytoplasm of hepatocytes and damage to liver cells due to toxic effect and or sucking blood by ticks leading to anemia and decrease in RBC counts results in hypoxia and decrease in food intake and consequently the body consumes energy stored causing stress in liver, muscles and cardiac muscles [23]. Significant increased AST, ALT and LDH are also accompanied by an increase in CK concentration due to excessive damage in liver and muscles to increase catabolism processes to compensate energy due to increase in the anaerobic metabolic process [23,24]; this confirms our results in (Table3) where Creatinine has reported very high significant increase while Glucose and total Protein have no significant increase. All these biochemical changes lead to leakage of enzymes into the blood stream and these results match with the results [25]. There was no significant change with control group in CRP activity which reveals no inflammations or other secondary infections and this correlates with [23].

Results of biochemical parameters in (Table 3), indicated very high significant decrease level in Urea, Creatinine, TC and LDL concentration which recorded 47.78 ± 1.54 mmol/L, 1.06 ± 0.01 μ mol/L, 101 ± 2.5 mg/dL and 45.24 ± 2.02 mg/dL compared with control group which recorded 57.76 ± 0.92 mmol/L, 1.4 ± 0.03 μ mol/L, 134.5 ± 4.2 mg/dL and 65.2 ± 8.2 mg/dL respectively. Troponin reported positive compared with negative for control group. TG and VLDL recorded significant decrease 127.9 ± 7.7 and 25.58 ± 1.54 compared with control group which recorded 165.5 ± 14.8 mg/dL and 33.10 ± 2.96 mg/dL respectively. There was no significant level in T. Protein, Globulin, Uric acid, Glucose and HDL.

Results also showed a significant decrease in TC and TG is correlated to loss in appetite due to the suffering of the infested cat from hypoxia which led to decrease in storage of LDL in the body. The positive result of Troponin confirms the stress in the heart function of the infested cat and match the results of [23]. The significant decrease in Albumin in the serum level confirms the presence of hepatic and parasitic disease, also a significant decrease in Urea correlates to excessive catabolism on amino acids this is in coordinate with the results of [23,25].

The results in (Table 4) showed that there is an inverse correlation of ALP activity with ALT, T. Protein, Albumin, Globulin, Urea, TG, TC and Hb parameters, while there is a direct correlation with Glucose, in infested cats. This is reflected on the defect in the functions of liver leading to disorder or increase of enzymes responsible for distress of liver functions which correlates with [23].

Results in (Table 5) showed that there is an inverse correlation of LDH activity with T. Protein, Albumin, Globulin, Creatinine and HDL

parameters while it recorded a direct correlation with ALT, AST and CK parameters in infested cats. This reflects disorder or increase of the heart muscles due to increase of enzymes functions concerned with liver muscles and which is connected directly with LDH. This correlates with [23].

Results in (Table 6) showed that there is an inverse correlation of CK activity with Glucose, HDL and Hb parameters while there is a direct correlation with AST, LDH and LDL parameters in infested cats. This showed that the enzymes functions of heart are connected directly with each other and their increase indicates a disorder in the heart muscles functions which correlates with [23].

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Conflict of interest

No conflict of interest

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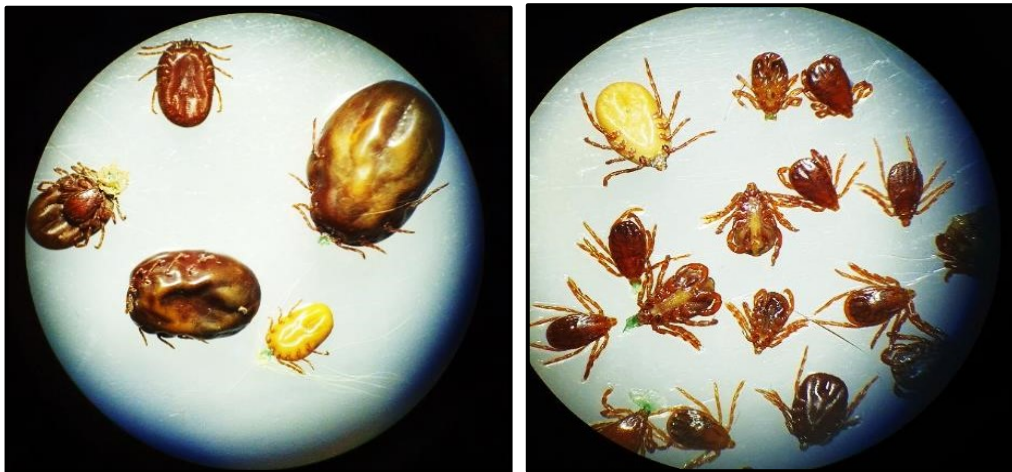


Fig. 1. *Rhipicephalus* spp. a) Engorged females b) Males

TABLE 1. Blood parameters of infested cats compared with control group

Parameters	Groups	Mean \pm SE	P- value
PCV %	Infested	28.75 \pm 1.12 ***	P \leq 0.001
	Control	37 \pm 0.33	
Hb g/100 ml	Infested	8.75 \pm 0.34 ***	P \leq 0.001
	Control	12.3 \pm 0.10	
ESR mm/24 h	Infested	7.75 \pm 1.39 ***	P \leq 0.001
	Control	18 \pm 0.33	
WBC x103microliter	Infested	7175 \pm 352.1	P > 0.05
	Control	7675 \pm 258.3	
RBC x106microliter	Infested	3435000 \pm 184458 ***	P \leq 0.001
	Control	5755000 \pm 458333	
LYMPH	Infested	9.5 \pm 0.17 ***	P \leq 0.001
	Control	75.5 \pm 1.67	

*** Correlation is significant at 0.001 level

TABLE 2. Levels of serum enzymes activity of infested cats compared with control group

Parameters	Groups	Mean \pm SE	P- value
ALT, U/L	Infested	41.03 \pm 4.52*	P \leq 0.05
	Control	29.4 \pm 3.27	
AST, U/L	Infested	99.53 \pm 16.44 **	P \leq 0.01
	Control	52.8 \pm 5.20	
ALP, U/L	Infested	154 \pm 8.5***	P \leq 0.001
	Control	28.5 \pm 2.5	
LDH, U/L	Infested	605.75 \pm 47.61 **	P \leq 0.01
	Control	266 \pm 4.33	
CRP, U/L	Infested	4.5 \pm 0.4	P > 0.05
	Control	4.2 \pm 0.3	
CK, U/L	Infested	242.25 \pm 16.19**	P \leq 0.01
	Control	77.5 \pm 2.5	

*** Correlation is significant at 0.001 level.

** Correlation is significant at 0.01 level.

* Correlation is significant at 0.05 level.

TABLE 3. Biochemical parameters of infested cats with tick groups and control groups

Parameters	Groups	Mean \pm SE	P- value
T. Protein, g/dL	Infested	6.53 \pm 0.25	P> 0.05
	Control	6.75 \pm 0.18	
Albumin, g/dL	Infested	3.28 \pm 0.14**	P \leq 0.01
	Control	3.65 \pm 0.15	
Globulin, g/dL	Infested	3.25 \pm 0.2	P> 0.05
	Control	3.1 \pm 0.13	
Urea, mmol/L	Infested	47.78 \pm 1.54 ***	P \leq 0.001
	Control	57.76 \pm 0.92	
Creatinine, μ mol/L	Infested	1.06 \pm 0.01***	P \leq 0.001
	Control	1.4 \pm 0.03	
Uric acid	Infested	1.8 \pm 0.2	P>0.05
	Control	1.6 \pm 0.25	
Glucose, mmol/L	Infested	108.5 \pm 4.8	P>0.05
	Control	99 \pm 4.3	
TC, mg/dL	Infested	101 \pm 2.5 ***	P \leq 0.001
	Control	134.5 \pm 4.2	
TG, mg/dL	Infested	127.9 \pm 7.7**	P \leq 0.01
	Control	165.5 \pm 14.8	
HDL, mg/dL	Infested	30.43 \pm 1.93	P>0.05
	Control	36.2 \pm 9.4	
LDL, mg/dL	Infested	45.24 \pm 2.02***	P \leq 0.001
	Control	65.2 \pm 8.2	
VLDL, mg/dL	Infested	25.58 \pm 1.54 **	P \leq 0.01
	Control	33.10 \pm 2.96	
Troponin	Infested	Positive ***	P \leq 0.001
	Control	negative	

*** Correlation is significant at 0.001 level.

** Correlation is significant at 0.01 level.

* Correlation is significant at 0.05 level.

TABLE 4. Correlation of ALP activity with parameters in infested group

Parameters	r ²	P- Value
ALT	-0.539	P \leq 0.05
T.G.	-0.956	P \leq 0.001
T. Protein	-0.882	P \leq 0.001
Urea	-0.915	P \leq 0.001
Albumin	-0.931	P \leq 0.001
Glucose	0.538	P \leq 0.05
Globulin	-0.865	P \leq 0.001
T.C.	-0.563	P \leq 0.01
Hb	-0.830	P \leq 0.001

*** Correlation is significant at 0.001 level.

** Correlation is significant at 0.01 level.

* Correlation is significant at 0.05 level.

TABLE 5. Correlation of LDH activity with parameters in infested group

Parameters	r ²	P- Value
ALT	0.708	P≤ 0.001
AST	0.782	P≤0.001
T. C.	-0.852	P≤ 0.01
T. Protein	-0.451	P≤0.05
Albumin	-0.505	P≤ 0.05
CK	0.567	P≤ 0.01
Globulin	-0.436	P≤0.05
Creatinine	-0.757	P≤0.001
HDL	-0.723	P≤0.001

*** Correlation is significant at 0.001 level

** Correlation is significant at 0.01 level

* Correlation is significant at 0.05 level

TABLE 6. Correlation of CK activity with parameters in infested group

Parameters	r ²	P- Value
AST	0.782	P≤0.001
Glucose	-0.659	P≤0.01
LDH	0.567	P≤0.01
HDL	-0.978	P≤0.001
LDL	0.521	P≤0.05
Hb	-0.624	P≤0.01

*** Correlation is significant at 0.001 level.

** Correlation is significant at 0.01 level.

* Correlation is significant at 0.05 level.

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دراسة بعض المتغيرات الكيموحيوية والدموية في دم القطط السانبة المصابة بالقراد

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الخلاصة

تم هذه الدراسة بجمع القطط عشوائيا من مناطق مختلفة من مدينة الموصل بين تشرين الأول 2022 وحزيران 2023 ومن خلال فحص 64 قطة مصابة بالقراد ، وجد انها مصابه بنوعين من القراد الصلب ينتميان إلى جنس *Rhipicephalus* وهما *R. sanguineus* و *R. turanicus* . وأظهرت النتائج وجود انخفاض معنوي في المتغيرات الدموية والتي تضمنت مستوى الهيموكلوبين وحجم خلايا الدم الحمر المتكدسة وسرعة ترسب خلايا الدم الحمر ونسبة خلايا الدم الحمر وعدد الخلايا اللمفاوية والتي كانت 28.75 و 8.75 و 7.75 و 3435000 و 9.5 على التوالي.

كما وجد زيادة معنوية عالية جدا في فعالية انزيم الفوسفاتيز القاعدي لدى مجموعة المرضى والتي بلغت 154U/L ، وكذلك زيادة معنوية عالية في فعالية كل من الاسبارتيت ناقل الأمين ولاكتيت ديهيدروجينيز وكرياتين كابينيز لدى مجموعة المرضى والتي بلغت 99.53U/L و 605.75U/L و 242.25U/L على التوالي مقارنة بمجموعة السيطرة والتي بلغت 52.8U/L و 266U/L و 77.5 U/L على التوالي. بينما أظهرت النتائج وجود زيادة معنوية في فعالية انزيم الالانين ناقل الأمين في مجموعة المرضى 41.03U/L مقارنة بمجموعة السيطرة 29.4U/L .

وبينت النتائج وجود ارتباط معنوي بين زيادة فعالية الاسبارتيت ناقل الأمين والالانين ناقل الأمين ولاكتيت ديهيدروجينيز مع زيادة فعالية الكرياتين كابينيز. وأظهرت النتائج انخفاض في مستوى اليوريا والكرياتينين والكوليسترول الكلي والبروتين الدهني واطى الكثافة وكانت 47.78mmol/L و 1.06µmol/L و 101mg/dL و 45.24 mg/dL على التوالي مقارنة بمجموعة السيطرة 57.76 mmol/L و 1.4µmol/L و 134.5 mg/dL و 65.2 mg/dL على التوالي . كما تبين وجود نتيجة موجبة لاختبار التروبونين في مجموعة المرضى . كما لوحظ انخفاض معنوي في مستوى الدهون الثلاثية والبروتين الدهني واطى الكثافة جدا في مجموعة المرض 127.9g/dL و 25.58mg/dL مقارنة بمجموعة السيطرة 165.5mg/dL و 33.10 mg/dL على التوالي .

وبينت النتائج وجود علاقة معنوية لكل من انزيم الفوسفاتيز القاعدي ولاكتيت ديهيدروجينيز والكرياتين كابينيز مع عدد من المتغيرات الكيموحيوية المقاسة في مجموعة القطط المصابة بالقراد

الكلمات المفتاحية: القطط ، القراد ، امراض الدم ، متغيرات كيموحيوية ، لاكتيت ديهيدروجينيز.