Correlation between Platelets and Red Blood Cells Parameters in Cattle Theileriosis

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Abstract: The purpose of the study is to investigate the values for platelets (PLT) count, plateletcrit (PCT), mean platelet volume (MPV), platelet distribution width (PDW) and the correlation with the parallel red blood cell parameters, packed cell volume (PCV), mean corpuscular volume (MCV), and red blood cell distribution width (RDW) in cattle Theileriosis. A total number of 25 cows were subjected to study. Out of them 18 cows were suffered from Theileriosis, the remained 7 cows were clinically healthy and kept as control. Red blood cells (RBCs) and platelet indices were measured in whole blood samples collected on EDTA. Animals infected with Theileria were classified into two groups based on total erythrocytes count. Group 1: included animals that had total RBCs count above $5 \times 10^6/mm^3$. Group 2: included animals that had total RBCs count below $5 \times 10^6/mm^3$. Comparing data from theileria infected groups with the control group revealed that there was a significant decrease in total RBCs count only in group 2 ($p<0.01$). MCV showed significant decreases in group 1 ($p<0.01$) and group 2 ($p<0.05$), PCV was significantly decreased in both groups ($p<0.01$), RDW was significantly increased only in group 2 ($p<0.05$), PLT count was significantly decreased only in group 2 ($p<0.05$), PCT was significantly decreased only in group 2 ($p<0.05$), no significant changes were observed in MPV and PDW. Comparing data from group 1 with group 2 revealed that RBCs count, PCV and PLT count were significantly higher in group 1 than group 2. Furthermore, MCV value was significantly higher in group 2 than group 1. RDW was significantly higher in group 2 than group 1. The present study revealed that in cattle Theileriosis, PLT indices greatly affected by the degree of anemia. Furthermore, the decrease in PLT count and PCT usually accompany oligocythemia.

Keywords: Platelets, Theileria, RBCs, PCT, MPV.

INTRODUCTION

Tropical theileriosis is one of the most prevalent and economically important diseases of cattle. The principle causative agent of bovine theileriosis is the protozoan parasite *Theileria annulata* and transmitted by the ticks of the genus Hyalomma. The disease is observed in South Europe, North Africa, middle and South Asia and the Middle East and Threatens approximately 250 million cattle [1]. Theileriosis causes serious economic losses through mortality and loss of productivity [2, 3].

Platelets (PLT) are anucleate cells with no DNA, derived from their precursor, the megakaryocyte (MK), whose differentiation is characterized by nuclear polyploidization through a process called endomitosis [4]. Platelet count is a part of complete blood cell count. At present, the complete blood cell count can be performed using an automated hematology analyzer, which can increase the throughput of the test. Recently, new indices related to erythrocytes, and platelet counts have been provided by hematologic analyzers [5].

Concerning the platelet parameter, the three important parameters are plateletcrit (PCT), mean

platelet volume (MPV), platelet distribution width (PDW), which can be yielded from the analysis. Little is documented in the literature regarding the clinical interpretation of these parameters in cattle theileriosis. MPV is the best known of those three parameters. Platelet volume is a marker of platelet function and activation [6]. In very general terms, increased MPV might be expected in "regenerative" thrombocytopenia, i.e., that caused by increased peripheral loss, destruction, or utilization of platelets and accompanied by increased production of platelets by marrow (megakaryocytic hyperplasia) [7]. PCT is a measurement derived from the platelet count and the mean platelet volume. PDW is a measurement derived from direct flow cytometric measurement of platelet cell volume, are less documented for their clinical roles [4, 5]. The purpose of the study is to investigate values for PLT count, PCT, MPV and PDW and the correlation with the parallel red blood cell parameters; packed cell volume (PCV), mean corpuscular volume (MCV), and red blood cell distribution width (RDW) in cattle Theileriosis.

MATERIALS AND METHODS

Animals

A total number of 25 cows were subjected to study. Out of them 18 cows were presented to the Veterinary Teaching Hospital, Assiut University, showed high

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fever 40-41.5°C, enlargement of superficial lymph nodes, and infestation with ticks. Some cases accompanied with corneal opacity and lacrimation and represent the theileria infected group. The remained animals (No. = 7) were selected from clinically healthy cows and kept as the control group.

Samples

Blood samples were collected from control cows and from theileria infected group. Drop of blood from the ear vein was used for making blood film according to Coles [8]. Blood smears were fixed in absolute methyl alcohol, stained with Giemsa stain and examined under the oil immersion lens (x100).

Whole blood samples were collected from the jugular vein in EDTA vacutainer tubes. Hematological analysis was carried out by means of automatic blood cell counter (Medonic CA 620, Sweden).

Statistical Analysis

Data from all laboratory examinations in this study were systematically comprehensively collected for further statistical analysis. The statistical analysis of the results was carried out with SPSS 10.0 for Windows Program (SPSS, version 10.0, Chicago, IL, USA). The Kolmogorov-Smirnov test was used to check for normal distributions of the laboratory results in each parameter and normal distributions in all parameters were detected. Statistical significance between the studied groups was calculated using least significant difference. The correlation between red blood cell and platelet parameters was assessed using regression analysis. The statistical significant difference was accepted at *P* value ≤ 0.05.

RESULTS

Blood Smears

Beside clinical signs of theileriosis, diagnosis of theileria infection was confirmed by findings intracellular signet ring of theileria trophozoites in blood smear.

Animals

Animals infected with Theileria were classified into two groups based on total erythrocytes count. Group 1 (Normal RBCS count): included animals that had total RBCs count above 5×10^6/mm^3. Group 2 (Anemic): included animals that had total RBCs count below 5×10^6/mm^3 [9].

Values of RBCS and Platelets indices in Theileria Infected Groups

Comparing data from theileria infected groups with the control group revealed that there was a significant decrease in total RBCs count only in group 2 (p<0.01). MCV showed significant decreases in group 1 (p<0.01) and group 2 (p<0.05), PCV was significantly decreased in both groups (p<0.01), RDW was significantly increased only in group 2 (p<0.05), PLT count was significantly decreased only in group 2 (p<0.05), PCT was significantly decreased only in group 2 (p<0.05), no significant changes were observed in MPV and PDW.

Comparing data from group 1 with group 2 revealed that RBCs count, PCV and PLT count were significantly higher in group 1 than group 2. Furthermore, MCV value was significantly higher in group 2 than group 1. RDW was significantly higher in group 2 than group 1 (Table **1**).

Table 1:   Values of Platelet and Red Blood Cell Parameters in Cattle Theileriosis

		Theileria	
	Control group (No. 7)	Group 1 (No. 9)	Group 2 (No. 9)
RBCs count (x10^6)/mm^3	7.00 ± 0.97a	7.08±1.06ac	4.47±0.35b
MCV (fl)	46.84 ± 3.41a	34.68±3.70c	40.44±3.88b
PCV (%)	32.86±5.32a	24.52±4.16c	17.98±0.46b
RDW (%)	25.58±2.09a	25.88±3.93ac	31.78±6.29b
PLT count (x10^3)/mm^3	364.20±153.11a	294.50±141.21ab	178.80±106.33b
MPV (fl)	6.0±0.39a	6.55±0.98a	6.16±0.59a
PCT (%)	0.22±0.10a	0.19±0.09ab	0.1±0.05b
PDW (%)	9.88±1.15a	10.35±0.62a	10.28±1.43a

Data expressed as mean ± SD, at each row, different letter means significant (*P*<0.05)

Table 2:   Correlation between RBCS and Platelets Indices in Group 1

	RBCs count $(\times10^6)/mm^3$	MCV (fl)	RDW (%)	PCV (%)	PLT count $(\times10^3)/mm^3$	MPV (fl)	PDW (%)	PCT (%)
RBCs count $(\times10^6)/mm^3$	1	-0.175	-0.062	0.787*	0.609	0.153	0.802*	0.656
MCV (fl)		1	0.351	0.468	-0.227	-0.850*	-0.524	-0.424
RDW (%)			1	0.128	0.497	-0.393	-0.308	0.391
PCV (%)				1	0.363	-0.373	0.407	0.287
PLT count $(\times10^3)/mm^3$					1	-0.077	0.312	0.972**
MPV (fl)						1	0.501	0.159
PDW (%)							1	0.448
PCT (%)								1

*: significant (P<0.05), **: highly significant (P<0.01)

Correlation between RBCS and Platelets Indices in Theileria Infected Groups

Group 1

Erythrocytes count showed a significant positive correlation with PCV and PDW (P <0.05). MCV showed a significant negative correlation with MPV (P <0.05). PLT count showed a significant positive correlation with PCT (P <0.01) (Table **2**).

Group 2 (Anemic Group)

Erythrocytes count showed a significant negative correlation (P <0.01) with MCV and RDW. MCV showed a significant positive correlation with RDW (P <0.01) and PCV (P <0.05). RDW was negatively correlated with PCV (P <0.05). PLT count showed a significant positive correlation with MPV (P <0.01), PDW (P <0.05) and PCT (P <0.01). Furthermore, MPV showed a significant positive correlation with PDW (P <0.01) and a negative correlation with PCT (P <0.01). PDW was negatively correlated with PCT (P <0.01) (Table **3**).

DISCUSSION

The quantitation of platelets in the peripheral blood is a well-recognized tool. However, other platelet parameters that recently have become available on a routine basis with the introduction of automated cell analyzers may become increasingly important in evaluating the integrity of the thrombocytic function [10-13].

In the present study, cows infected with theileria were classified into two groups based on the total RBCs count; animals that had a normal count were referred as group 1, however, animals with anemia were referred as group 2. Red blood cells and platelet indices for group 1 showed significant decreases in MCV and PCV when compared with the control group. In addition, the decrease in MCV was significantly lower than group 2, the significant decrease in PCV in group 1 may be attributed to microcytic RBCs. However, in group 2 the significant decrease in PCV may be attributed to oligocythemia [9] (Table **1**).

Table 3:   Correlation between RBCS and Platelets Indices in Group 2

	RBCs count $(\times10^6)/mm^3$	MCV (fl)	RDW (%)	PCV (%)	PLT count $(\times10^3)/mm^3$	MPV (fl)	PDW (%)	PCT (%)
RBCs count $(\times10^6)/mm^3$	1	-0.966**	-0.909**	-0.593	-0.345	0.283	0.592	-0.437
MCV (fl)		1	0.983**	0.781*	0.095	-0.026	-0.364	0.196
RDW (%)			1	0.860*	-0.041	0.122	-0.220	0.066
PCV (%)				1	-0.544	0.604	0.298	-0.452
PLT count $(\times10^3)/mm^3$					1	0.992**	0.956*	0.994**
MPV (fl)						1	0.940**	-0.974**
PDW (%)							1	-0.974**
PCT (%)								1

*: significant (*P* <0.05), **: highly significant (*P* <0.01).

Platelets count and indices showed insignificant changes in group 1, However, PLT count and PCT were significantly decreased in anemic group 2. The significant decrease in PCT ($p < 0.01$) is attributed to the significant thrombocytopenia ($p < 0.01$) [9].

The correlation between RBCs and platelets indices in group 1 revealed that erythrocytes count showed a significant positive correlation with PCV and PDW ($P < 0.05$). MCV showed a significant negative correlation with MPV ($P < 0.05$). PLT count showed a significant positive correlation with PCT ($P < 0.01$). The positive correlation between RBCs count and PCV and between PLT count and PCT was established. However, the correlation between RBCs count and PDW and between MCV and MPV need further research.

In group 2, RBCs count showed a significant negative correlation ($P < 0.01$) with MCV and RDW. Which may be attributed to the oligocythemia observed in animals belong to this group. MCV showed a significant positive correlation with RDW ($P < 0.01$) and PCV ($P < 0.05$). RDW was negatively correlated with PCV ($P < 0.05$). PLT count showed a significant positive correlation with MPV ($P < 0.01$), PDW ($P < 0.05$) and PCT ($P < 0.01$). Furthermore, MPV showed a significant positive correlation with PDW ($P < 0.01$) and a negative correlation with PCT ($P < 0.01$). PDW was negatively correlated with PCT ($P < 0.01$). Clinically, platelet volume measurements have long been of interest to researchers concerned with platelet production. MPV correlates with platelet function and activation, whether measured as aggregation, thromboxane synthesis, beta-thromboglobulin release, procoagulant function, or adhesion molecule expression [7]. Concerning PCT, there is an evidence supporting that PCT, rather than platelet counts, predicts the risk of bleeding in patients with thrombocytopenia [11]. PDW is a quantitative assessment of platelet size and volume and it is of limited usefulness in distinguishing between reactive thrombocytosis and essential thrombocythemia. PDW is increased in the presence of platelet anisocytosis

[12]. The present study revealed that in cattle Theileriosis, PLT indices greatly affected by the degree of anemia. Furthermore, the decrease in PLT count and PCT usually accompany oligocythemia.

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