THE HEMATOLOGICAL EFFECT OF *SALMONELLA TYPHIMURIUM* ENDOTOXIN IN RABBITS.

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ABSETRACT

End toxin is responsible for different changes in body systems. This study was conducted to study hematological changes by using 20 rabbits, were randomly divided into 4 equal groups, then gave intravenous endotoxin doses 5, 15 and 20 µg/Kg body weight for groups I, II and III respectively, while group IV gave *PBS* as a control.

The hematological findings included marked leukopenia due to neutropenia followed by marked leukocytosis with left shift associated with lymphocytosis, monocytosis and basophilia. Total erythrocytes, packed cell volume and hemoglobin concentration were increased during first hour, while the following time showed gradual decrease to develop anemia, which manifested by macrocytic hypochromic, in relation to the increased mean corpuscular volume and decreased mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration. Also thrombocytopenia, while the total plasma protein and fibrinogen showed pronounced increased due to endotoxemia.

INTRODUCTION

The poor out come of gram negative bacterial sepsis is believed to be due to lipopolysaccharid (LPS), and lethal endotoxemia has been extensively used as an experimental model of gram negative septic shock **(1)**, that endotoxemia in animals produced initially marked leukopenia, which characterized by reduction in circulating neutrophils as well as eosinophiles, monocytes,and lymphocytes in addition to marked thrombocytopenia**(2, 3, 4**&**5)**, then followed by marked leukocytosis as late response, this occurs because of the increase in neutrophils with pronounced shift to the left, also lymphocytosis and monocytosis **(2,5**&**6)**.

Endotoxin because erythrocytosis due to splenic contraction, which followed by increased packed cell volume, that showed in a progressive increased at 3 hours post injection **(7** & **8)**

Studies in horses showed a high level of hemoglobin concentration at first 3 hours post induced endotoxemic shock **(8)**, but others founded that hemoglobin concentration was decreased in response to endotoxemia**(9)**.

Authors explained that endotoxemia lead to significant increased in total plasma protein level after 2 hours **(8)**, also fibrinogen as one of the important acute phase proteins, which produced by liver, endotoxin would affect fibrinogen by reducing its blood level at first hour post injection **(10)**.

This study aimed to disclose the effect of endotoxin on blood in rabbits which includes: total leukocytes count, differential leukocytes cells count, total erythrocytes count, packed cell volume (PCV), hemoglobin concentration (Hb), fibrinogen and total plasma protein (TPP) during 20 days period.

MATERIALS AND METHODS

Twenty adult healthy male rabbits, domestic breed were used, weighted between 1.5 -1.9 Kg. They reared in separated cages .Those rabbits divided into 4 equal groups, and given endotoxin intravenously in doses of 5, 15 and 20 µg/Kg body weight for groups I, II and III respectively, while group IV gave PBS as a control. Blood samples were collected from ear vein in 5ml EDTA coated vials, that was done at (0, 1,6,12 and 24) hours, followed by daily sampling until the day 20^{th} .

Blood smears were stained by Leishman´s stain to determine neutrophils, eosinophils, basophiles, monocytes and lymphocytes ratio, as well as hemocytometer method to determined the erythrocyte, leukocytes and thrombocytes numbers **(11).**

The packed cell volume (PCV) was estimated by hematocrit method and hemoglobin concentration (Hb) by acid hematin, spectrophotometer **(12)**.

The erythrocyte indices: mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated **(11)**

Total plasma protein (TPP) and fibrinogen were estimated by refractmeter method; the procedure was adapted from **(12)**

Reference of endotoxin:

Salmonella typhimurium endotoxin, lyophilized (Difco Laboratories- Ditroit, Michigan, USA, number 706385).

Statistical analysis:

By two ways ANOVA and the mean difference is significant at the 0.05 level in using statistical package for social sciences (SPSS).

RESULTS AND DISCUSSION

The first hour following intravenous injection of endotoxin there was sharp decreased in total leukocyte count as in table(1) due to neutropenia, eosinopenia and monocytopenia in groups I ,II and III compared to the control as shown in tables (2,4 & 6) that were in response to endotoxin induced recruitment of such type of cells in tissues of organs like lung liver and kidneys **(13)** or that decrease may due to bone marrow depletion, then after showed higher leukocytic rates : III , II and I respectively than control was significant ($P < 0.05$) as in table(1), the leukocytosis, was manifested mainly by band cells, basophilia, monocytosis and lymphocytosis (tables-3,5,6 & 7), all these changes were due to the activation of bone marrow and lead to release of high number of leukocytes following endotoxemia with shift to the left **(2 & 5).**that in response to late activation of bone marrow following endotoxemia(14).

There was significant decrease in the number of eosinophils in groups I and II but non significant for group III as in table (4), these differences may be also related to bone marrow responsiveness substituted recruitment of eosinophils in body organs following endotoxemia **(15)**.

Total erythrocytes count during 1-6 hours showed a clear increase in injected groups as in table(8), which occur in response to splenic contraction **(7**& **8)**, but the following time of this study noticed development of anemia in three groups while the control was normal . The interpretation of this decrease, that the endotoxin bind to erythrocytes and increased their fragility then subsequent shortage the lifespan by hemolysis **(16)**, these changes were more prominent in group III, which seems to be dose dependant .

The packed cell volume (PCV) and hemoglobin (Hb) concentration both showed increase at the first hour as in tables(9&10), while during the following time these results reversed to show significant less than control, these results were related to changes of total erythrocytes number of three groups **(12)**.

The erythrocytic indices revealed high mean corpuscular volume (MCV) showed in table (11), as a result of increased erythropoiesis in response to anemia, and presence of macrocytic erythrocytes in high number **(15)**.

The mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC), both values were less than control group(tables-12&13), related to increased number of macrocytic erythrocytes, which may be immature and contain low level of hemoglobin, these changes reported in association with hypochromic anemia**(17)**. But MCH values in rabbits of group III showed non significant higher values than control group. This alteration was referred to intravascular hemolysis due to increased erythrocytes fragility, and then released their hemoglobin following endotoxemia, and then after the end result was relative increased in MCH value **(15 & 16)**.

The erythrocytes parameters as in tables (8, 9,10,11,12 and 13) indicated the development of macrocytic –hypochromic type of anemia in rabbits in this study following endotoxemia and was seems to be dose dependant of endotoxin.

Total platelets numbers of groups I, II and III with sharp decrease at first hour were in table (14) in general the rates from lower to higher were; group III, II and I significantly less than control group rabbits ($P < 0.05$), the thrombocytopenia was occurred in response to increased level of platelets activating factor (PAF) following endotoxemia which enhanced platelets adherence and aggregation following endotoxemia **(13** & **14)**.

The total plasma protein (TPP) and fibrinogen were significantly increased in three groups of rabbits than control as in tables (15&16), which were more prominent in the third group. That increasing values were attributed to the activity of hepatocytes and kupffer cells, also subsequent increased level of gamma globulin, that endotoxin act as mitogen and subsequent activation of enzymatic system of hepatocytes **(18, 19** & **20)**.

Note: The result of absolute leukocytes number were replaced by relative count (%), because the similarities in their changes and statistical analysis.

Table (1)The result of total Leukocytes count ($x10^9$ \ L) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I*	R	14.19	4.10	15.97	35.50	35.36	29.76	22.57	17.71	16.51	17.42	16.52	15.65	15.35	15.08	15.12	14.28	16.20	15.57	14.62	15.01	13.70	14.25	14.10	14.20
	SD	±1.62	±1.19	±2.15	±16.52	±12.15	±7.72	±6.18	±2.05	±1.50	±2.72	±1.69	±1.83	±1.88	±0.96	±1.57	±0.90	±0.77	±0.81	±1.59	±1.64	.	.	.	.
II*	R	13.86	3.60	11.30	25.07	30.65	18.28	21.80	22.40	14.80	21.45	18.02	17.07	16.03	15.80	16.08	16.18	15.32	15.67	15.22	15.80	15.60	14.25	14.65	15.59
	SD	±3.06	±1.29	±3.45	±13.11	±1.85	±1.85.	±3.75	±3.84	±0.14	±4.89	±3.95	±2.36	±1.14	±0.76	±1.00	±0.10	±0.67	±0.60	±7.53	±3.81	.	.	.	.
III*	R	14.50	2.57	6.09	13.92	10.94	13.36.	16.37	20.86	15.86	13.76	15.37	16.62	13.40	13.89	13.77	13.88	12.92	13.90	12.55	13.45	15.15	14.78	14.50	14.34
	SD	±1.66	±0.57	±2.80	±7.83	±5.39	±5.65	±5.48	±5.84	±3.41	±2.15	±1.33	±0.41	±2.31	±1.96	±1.61	±0.96	±2.51	±1.97	±3.39	±1.34	.	.	.	.
IV	R	13.33	13.51	13.43	13.47	13.33	13.32	12.84	12.58	12.91	13.15	12.92	12.83	12.92	12.67	13.21	12.83	12.83	12.96	12.75	12.74	12.86	12.74	12.81	12.84
	SD	±2.70	±2.52	±1.98	±2.27	±2.63	±2.40	±2.65	±2.43	±2.54	±2.19	±2.42	±2.46	±2.26	±2.59	±2.54	±2.49	±2.48	±2.70	±2.54	±2.76	±2.79	±2.54	±2.49	±2.39

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (2) Neutrophiles percentage (%) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	12h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I	R	43.52	10.2*	50.04*	59.52*	63.40*	62.88*	43.00	42.78	38.40	44.25	45.12	40.75	50.50	47.83	41.83	40.56	42.00	39.70	37.50	38.30	39.50	30.50	45.00	57.40
	SD	±2.42	±2.99	±31.05	±10.29	±11.36	±6.36	±6.17	±9.37	±8.94	±9.06	±12.45	±6.11	±12.3	±6.25	±2.36	±1.60	±7.07	±12.02	±3.53	±8.20	.	.	.	.
II	R	42.20	5.04*	41.44*	64.44*	39.26*	52.44*	38.22	35.70	36.20	39.57	42.35	36.25	36.43	48.90	47.76	45.06	42.90	30.75	41.50	45.15	42.00	40.50	48.60	22.00
	SD	±7.74	±1.68	±13.70	±6.99	±21.88	±9.19	±13.26	±5.08	±10.1	±9.73	±12.59	±9.47	±8.86	±4.68	±3.41	±2.70	±4.80	±3.18	±1.41	±0.77	.	.	.	.
III	R	43.12	3.18*	16.30*	11.06*	22.26*	39.12	41.30	34.20	29.40	30.45	29.70	32.05	37.36	36.93	32.33	57.83	30.05	40.50	27.95	26.75	32.00	36.000	27.30	32.00
	SD	±4.95	±1.45	±19.83	±7.47	±11.62	±24.17	±12.58	±4.99	±6.29	±4.87	±5.90	±2.70	±9.80	±8.27	±9.29	±7.52	±0.35	±1.69	±4.17	±1.48	.	.	.	.
IV	R	48.66	49.24	48.18	45.96	45.10	44.36	44.54	42.92	43.26	44.88	43.92	43.04	44.26	44.16	42.44	43.72	46.26	43.06	46.24	44.98	46.64	43.96	46.38	47.30
	SD	±4.07	±4.71	±3.94	±5.03	±4.12	±4.41	±4.39	±4.07	±5.40	±4.01	±3.95	±3.91	±4.36	±2.65	±4.95	±3.68	±2.95	±2.06	±5.89	±6.70	±5.61	±5.94	±4.50	±3.64

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (3) Band cell percentage (%) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	12h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R	0.38	0.82	0.30	0.64	1.82	3.68	5.08	4.38	5.42	5.30	5.75	5.40	4.23	4.10	4.16	3.83	3.40	3.00	4.25	3.75	2.00	1.50	2.00	2.00
	SD	±0.60	±1.07	±0.67	±0.61	±1.11	±1.33	±1.22	±1.92	±2.18	±2.03	±0.64	±1.14	±2.15	±2.04	±1.98	±1.60	±2.26	±2.12	±1.06	±1.76	.	.	.	.
II*	R	0	0	0.04	1.56	1.76	3.80	4.52	3.66	5.20	4.92	4.77	4.05	4.83	4.50	4.36	4.30	3.50	2.85	4.45	4.85	4.10	3.20	2.20	2.50
	SD	±0	±0	±0.08	±2.78	±0.84	±2.49	±1.39	±1.84	±4.50	±3.96	±3.67	±3.61	±1.60	±1.83	±1.75	±2.25	±2.12	±1.20	±1.75	±1.85	.	.	.	.
III*	R	0.92	0.20	0.50	1.30	3.74	4.54	4.64	5.70	5.95	6.17	4.77	4.62	4.10	3.80	3.70	3.66	3.50	3.60	3.25	4.00	2.50	3.00	3.80	3.60
	SD	±1.32	±0.44	±1.11	±2.90	±2.17	±1.20	±1.86	±1.26	±0.52	±1.11	±1.33	±1.19	±0.79	±0.43	±1.05	±0.50	±0	±0.56	±2.47	±0.70	.	.	.	.
IV	R	0.70	0	0.20	0.60	0.60	0	0.34	0	0.50	0.32	0.28	0.60	0.24	0.30	0.32	0.04	0	0.02	0.04	0.24	0	0.20	0.32	0.37
	SD	±0.97	±0	±0.44	±0.82	±0.65	±0	±0.46	±0	±0.70	±0.46	±0.38	±1.23	±0.43	±0.67	±0.52	±0.08	±0	±0.04	±0.08	±0.43	±0	±0.44	±0.48	±0.47

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (4) Eosinophils percentage (%) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R	2.04	1.76	4.08	1.74	2.44	0.74	2.10	3.10	2.90	4.37	2.82	3.0	0.83	3.06	3.66	3.23	4.50	4.85	3.50	2.40	3.50	4.50	4.00	5.30
	SD	±1.52	± 2.12	±1.23	±0.72	± 1.23	±0.94	± 1.47	±1.77	± 1.12	± 1.65	± 1.44	±2.16	±0.76	±3.10	±1.52	±1.55	±2.12	±1.90	±0.70	±1.55	.	.	.	.
II*	R	2.72	0.92	1.38	2.48	2.02	1.86	1.90	3.96	4.00	2.65	2.82	2.22	1.70	2.66	2.60	4.46	2.70	2.50	3.75	3.20	4.00	3.50	6.90	4.20
	SD	±1.26	± 1.05	±1.33	±1.44	± 1.34	±0.69	± 1.64	±1.90	± 2.40	± 4.25	±0.49	±1.55	±0.26	±1.25	±0.45	±3.84	±3.53	±2.12	±1.06	±0.28	.	.	.	.
III	R	1.52	1.68	4.22	3.02	3.56	3.32	2.96	3.40	4.65	2.00	3.02	6.17	3.00	4.16	4.03	2.56	2.90	1.30	1.75	0.70	1.50	1.40	3.50	2.20
	SD	±1.23	± 1.50	±2.26	2.33	± 2.29	±3.37	± 1.25	4.99	± 2.15	±0.57	±3.78	±4.07	±5.19	±1.75	±1.95	±1.20	±0.70	±0.14	±1.06	±0.98	.	.	.	.
IV	R	4.02	3.72	3.98	3.20	3.22	2.60	2.80	3.62	3.68	3.62	2.36	4.02	3.56	3.72	3.92	4.76	3.62	3.54	3.38	4.30	3.22	3.42	3.14	3.38
	SD	±2.94	± 3.34	±2.30	±2.52	± 2.34	±2.21	± 1.12	±1.00	± 1.33	±0.64	± 1.48	±0.96	±1.58	±2.47	±1.43	±1.36	±1.40	±2.06	±1.63	±1.66	±1.73	±0.76	± 1.80	±1.07

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (5) Basophiles percentage (%) after endotoxin adminstration in I, II, III and control groups

Time / Group		0	1h	6h	12 h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I*	R	0.12	0.3	0.2	0.2	1.0	0.9	0.7	0.4	0.3	0.1	0.3	0.7	0.5	0.5	1.0	0.8	0	0.2	0.2	0.2	0.5	1.5	0	1.2
	SD	±0.17	±0.76	±0.4	±0.2	±1.5	±1.2	±1.1	±0.6	±0.4	±0.1	±0.6	±0.5	±0.8	±0.8	±0.8	±0.7	0	±0.3	±0.3	±0.3	.	.	.	.
II*	R	0.1	0.1	0.1	0.6	0.1	1.3	8.0	1.1	0.2	0.8	12	0.9	0.1	0.5	0.8	0.9	3.3	0.1	0.4	0.4	0	0.5	0.4	1.3
	SD	±0.3	±0.2	±0.1	±1.3	±0.3	±1.6	±0.1	±1.1	±0.5	±1.7	±0.2	±1.3	±0.2	±0.8	±1.0	±0.1	±2.6	±0.1	±7.0	±0.6	.	.	.	.
III*	R	4.0	0	0.5	0.4	0.4	1.1	0.7	0.4	0.2	0.37	0	0	0.8	0.5	2.1	.2	0	0	0.4	0.65	0	0.2	1.2	0
	SD	±8.9	0	±0.7	±0.8	±0.77	±1.0	±1.0	±0.9	±0.2	±0.47	0	0	±1.4	±0.5	±1.6	±0.2	0	0	±0.5	±0.9	.	.	.	.
IV	R	0.2	4.0	0.3	0.1	0	0	0.2	0.1	0.2	0	0	0.1	0.6	0.1	0.30	0.10	0.10	0.40	8.00	0.48	0	2.0	0.40	6.0
	SD	±0.4	±8.9	±0.4	±0.2	0	0	±0.4	±0.4	±0.4	0	0	±0.2	±0.8	±0.2	±0.4	±0.2	±0.2	±0.8	±0.1	±0.6	0	±4.47	±0.54	±0.13

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (6) Monocytes percentage (%) after endotoxin adminstration in I, II, III and control groups

Time Group		0h	1h	6h	2h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R		5.22	3.06	5.28	3.52	4.14	3.80	6.92	9.54	4.57	5.00	3.80	7.65	4.16	5.40	6.33	5.20	7.00	7.10	7.25	6.45	5.50	6.00	4.50	8.50
	SD		±0.92	±1.87	±2.96	±2.70	±2.05	±2.74	±2.64	±4.14	±1.93	±1.08	±0.72	±1.07	±0.35	±1.21	±1.04	±0.81	±2.12	±1.27	±1.06	±0.77	.	.	.	.
II*	R		4.80	3.00	3.58	2.30	5.46	5.58	5.32	7.36	7.12	4.50	7.30	5.80	5.70	6.83	5.36	8.16	9.25	7.15	5.55	6.35	4.00	5.50	4.20	9.50
	SD		±0.89	±1.64	±2.04	±0.90	±3.95	±0.82	±1.77	±3.24	±4.34	±2.23	±3.86	±1.33	±2.91	±3.12	±1.65	±0.76	±1.76	±1.20	±1.34	±0.49	.	.	.	.
III*	R		3.92	2.58	6.38	3.92	6.24	6.76	7.84	7.38	6.30	5.40	5.72	6.15	3.76	6.80	7.46	6.76	5.90	6.20	4.10	6.00	7.00	8.00	9.00	8.80
	SD		±0.90	±2.21	±4.08	±2.41	±1.01	±4.62	±3.30	±3.87	±2.30	±1.79	±1.77	±1.66	±2.40	±1.96	±2.20	±1.11	±0.42	±0.28	±1.41	±3.25	.	.	.	.
IV	R		O9	4.44	5.78	5.02	5.28	4.70	4.56	5.36	4.98	5.12	4.66	5.58	5.38	5.70	5.76	5.12	5.36	5.40	4.96	4.90	4.90	5.32	4.40	5.14
	SD		±2.00	±0.94	±1.15	±1.41	±1.30	±1.71	±1.91	±1.18	±1.00	±0.94	±1.43	±0.81	±1.17	±0.97	±1.09	±0.66	±1.32	±1.34	±1.00	±0.82	±1.12	±1.1	±1.51	±1.0

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (7) Lymphocytes percentage (%) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	12h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I*	R	47.9	84.62	40.30	35.22	29.0	31.68	47.22	44.24	53.95	46.20	48.7	47.85	44.2	47.76	47.16	49.50	47.0	48.0	52.0	51.0	51.0	57.5	46.5	27.6
	SD	±4.18	±5.18	±30.30	±11.65	±10.11	±5.73	±5.77	7.37 ±	±8.59	±6.58	±13.15	±6.50	±14.47	±4.25	±2.02	±2.64	±7.77	±11.59	±4.94	±8.48	.	.	.	.
II*	R	50.14	90.94	53.14	30.04	53.12	38.82	54.48	51.56	53.4	52.0	47.60	55.47	49.60	43.4	42.86	41.33	51.8	59.50	48.75	44.75	50.0	50.0	39.30	63.0
	SD	±8.35	±2.49	±12.57	±4.97	±19.52	±7.12	±10.53	±5.05	±8.94	±8.73	±8.32	±7.79	±17.75	±3.41	±3.82	±3.66	±8.48	±0.28	±1.76	±1.06	.	.	.	.
III*	R	51.38	92.56	72.56	79.86	66.68	49.62	47.20	54.52	59.45	61.77	59.72	55.55	55.03	53.23	54.0	32.56	61.05	49.05	65.8	59.40	59.50	54.40	58.0	57.0
	SD	±6.35	±4.31	±18.36	±11.38	±14.26	±17.19	±13.28	±6.05	±3.05	±2.86	±5.89	±7.20	±8.75	±7.50	±7.0	±9.63	±0.49	±2.05	±1.13	±5.51	.	.	.	.
IV	R	44.14	41.96	42.16	45.72	46.40	48.34	47.90	47.92	47.86	46.38	47.40	48.38	47.10	47.32	45.20	48.20	43.74	48.14	45.20	46.36	45.16	45.90	47.62	44.12
	SD	±6.48	±6.43	±6.60	±4.43	±5.28	±2.95	±3.52	±3.61	±6.07	±4.30	±3.28	±6.41	±4.99	±3.46	±1.86	±6.35	±3.36	±5.46	±4.90	±4.58	±3.84	±4.90	±7.69	±4.23

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (8) Total erythrocytes count means (x10^{12} \ L) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I*	R	4.92	5.28	5.27	4.86	4.69	4.66	4.69	4.78	4.73	4.92	4.88	4.70	4.59	4.57	4.51	4.51	4.44	4.49	4.62	4.64	4.76	4.88	4.76	4.90
	SD	±0.43	± 0.43	±0.48	±0.47	±0.52	±0.42	±0.27	±0.16	±0.12	±0.34	±0.21	±0.28	±0.20	±0.09	±0.23	±0.26	±0.22	±0.27	0.28 ±	±0.09	.	.	.	.
II*	R	5.25	6.12	5.91	5.53	4.97	4.79	4.65	4.58	4.57	4.62	4.42	4.46	4.17	4.27	4.30	4.39	4.29	4.36	4.38	4.33	5.20	5.25	5.33	5.35
	SD	±0.25	± 0.28	±0.54	±0.37	±0.55	±0.48	±0.52	±0.55	±0.61	±0.73	±0.55	±0.38	±0.17	±0.22	±0.30	±0.42	±0.72	±0.79	±0.98	±1.08	.	.	.	.
III*	R	5.14	5.86	5.51	4.61	4.37	3.91	3.83	3.79	3.77	3.84	3.82	4.07	4.06	4.06	4.09	4.08	3.54	3.52	3.53	3.55	4.90	5.02	5.08	5.22
	SD	±0.35	± 0.37	±0.44	±0.78	±0.83	±0.82	±0.71	±0.63	±0.75	±0.67	±0.76	±0.79	±1.00	±0.90	±1.07	±1.30	±1.54	±1.76	±1.68	±1.88	.	.	.	.
IV	R	5.04	4.96	5.09	5.10	5.01	4.95	5.07	5.09	5.16	5.07	5.10	5.05	4.87	5.02	5.01	5.04	4.98	5.06	5.09	5.02	4.91	5.03	5.07	5.01
	SD	±0.32	± 0.28	±0.28	±0.39	±0.49	±0.32	±0.15	±0.31	±0.29	±0.41	±0.36	±0.37	±0.48	±0.40	±0.39	±0.35	±0.31	±0.30	±0.24	±0.35	±0.29	± 0.47	±0.44	±0.44

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (9) Packed cell volume in L\L after endotoxin adminstration in I, II, III and control groups

Time Group		0h	1h	6h	2h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d	
I*	R		0.303	0.328	0.325	0.313	0.294	0.301	0.307	0.309	0.296	0.300	0.298	0.292	0.280	0.283	0.280	0.280	0.275	0.277	0.285	0.282	0.290	0.305	0.300	0..300
	SD		±0.018	±0.013	±0.018	±0.020	±0.034	±0.026	±0.022	±0.022	±0.015	±0.014	±0.014	±0.027	±0.020	±0.011	±0.018	±0.015	±0.021	±0.017	±0.021	±0.017	.	.	.	.
II*	R		0.324	0.344	0.354	0.340	0.318	0.302	0.301	0.301	0.286	0.287	0.276	0.267	0.250	0.251	0.255	0.258	0.252	0.255	0.255	0.252	0.300	0.300	0.310	0.310
	SD		±0.019	±0.048	±0.019	±0.017	±0.019	±0.035	±0.031	±0.029	±0.039	±0.032	±0.024	±0.021	±0.013	±0.010	±0.018	±0.025	±0.045	±0.049	±0.056	±0.060	.	.	.	.
III*	R		0.313	0.356	0.331	0.306	0.297	0.267	0.250	0.250	0.252	0.256	0.251	0.248	0.235	0.240	0.238	0.246	0.215	0.222	0.225	0.225	0.310	0.315	0.320	0.330
	SD		±0.026	±0.016	±0.021	±0.032	±0.030	±0.049	±0.052	±0.056	±0.068	±0.071	±0.071	±0.074	±0.087	±0.087	±0.090	±0.092	±0.106	±.11 67	±.1 06	±.120	.	.	.	.
IV	R		0.308	0.303	0.308	0.312	0.305	0.305	0.306	0.308	0.312	0.307	0.308	0.308	0.299	0.306	0.301	0.309	0.303	0.312	0.310	0.304	0.301	0.305	0.308	0.303
	SD		±0.017	±0.014	±0.017	±0.022	±0.024	±0.018	±0.089	±0.017	±0.017	±0.022	±0.022	±0.019	±0.027	±0.021	±0.023	±0.021	±0.018	±0.019	±0.018	±0.019	±0.020	±0.026	±0.022	±0.023

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (10) Hemoglobin concentration in g\ L after endotoxin adminstration in I, II, III and control IV groups

Time Group	0h	1h	6h	2h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R	121.0	124.5	2.1	115.0	115.5	120.8	122.2	115.7	114.	114.0	113.3	108.3	98.0	102.7	102.6	102.8	108.4	110.9	118.1	110.8	103.3	103.3	105.4	104.1
	SD	±17.7	±18.4	±13.3	±15.1	±13.6	±13.7	±15.7	±10.6	±7.9	±10.9	±10.5	±12.5	±21.0	±11.5	±13.3	±13.9	±10.7	±8.4	±3.6	±8.9	.	.	.	.
II*	R	137.4	142.4	138.5	132.3	127.5	124.1	125.5	122.4	117.0	113.2	106.9	107.3	104.1	108.3	104.2	105.0	94.8	98.7	101.4	102.1	117.1	117.1	120.3	122.2
	SD	±9.4	±1.9	±5.54	±7.2	±6.4	±7.1	±9.0	±6.2	±4.6	±7.5	±4.9	±9.7	5.3±	±5.6	±6.6	±8.6	±3.9	±12.0	±18.9	±20.4	.	.	.	.
III*	R	125.6	137.5	129.9	128.0	114.4	111.0	105.4	102.4	106.1	105.8	108.8	105.8	100.7	102.7	103.7	104.6	91.3	91.6	93.3	92.8	123.9	123.8	125.2	127.6
	SD	±10.6	±10.0	±11.7	±10.8	±8.3	±18.6	±19.3	±13.5	±15.9	±16.4	±18.6	±22.2	±29.7	±29.7	±32.3	±34.2	34.9 ±	±39.5	±35.6	±41.3	.	.	.	.
IV	R	131.8	128.9	131.3	132.0	130.5	130.3	130.7	131.5	132.6	129.8	131.2	129.8	127.8	130.3	130.9	132.8	130.1	132.0	132.5	130.7	129.2	131.1	130.6	130.5
	SD	±10.7	±10.2	±10.5	±11.8	±11.9	±10.1	±7.9	±10.3	±9.9	±11.9	±12.0	±9.1	±13.9	±11.7	±11.9	±12.9	±12.7	±12.1	±12.1	±12.1	±10.17	±11.78	±13.3	±12.2

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (11) Mean corpuscular volume in fL after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I*	R	61.72	62.34	61.81	64.52	62.61	64.64	65.43	64.66	62.44	61.17	61.15	62.14	60.95	61.97	61.96	62.09	61.89	61.72	61.73	60.85	60.92	62.50	63.02	61.12
	SD	±3.889	±4.333	±3.321	±3.888	±0.75	±2.58	±3.32	±4.49	±4.04	±2.99	±2.80	±2.30	±1.64	±1.25	±0.81	±0.25	±1.62	±0.14	±0.53	±2.51	.	.	.	.
II*	R	61.53	59.82	59.61	61.06	64.30	65.29	64.29	65.27	63.08	63.60	63.92	60.96	60.83	60.47	60.80	60.34	60.41	60.91	60.90	61.17	63.26	62.74	62.99	63.21
	SD	±2.61	±3.08	±2.40	±1.77	±5.90	±5.54	±1.01	±6.17	±2.65	±5.10	±3.94	±4.24	±3.51	±2.88	±2.92	±3.02	±3.13	±4.27	±3.74	±3.32	.	.	.	.
III*	R	60.76	60.72	60.10	66.99	69.00	67.91	65.10	65.04	66.35	64.86	64.15	60.54	57.12	57.60	57.54	59.49	59.88	62.80	63.82	63.29	63.26	62.74	62.99	63.21
	SD	±1.444	±1.955	±2.440	±5.74	±9.43	±10.83	±8.75	±13.70	±10.37	±11.3	±9.63	±8.81	±9.24	±9.80	±8.82	±5.09	±3.88	±1.60	±0.38	±0.32	.	.	.	.
IV	R	60.48	61.20	60.84	61.64	61.52	61.69	60.02	60.54	60.35	60.21	60.27	61.06	61.64	61.76	59.94	61.28	61.07	60.51	60.68	60.22	61.28	60.11	60.67	59.88
	SD	±1.772	±0.900	±0.388	±0.98	±1.68	±1.58	±1.88	±0.76	±0.77	±1.72	±1.12	±1.20	±0.77	±1.61	±0.75	±0.76	±0.58	±2.30	±1.53	±1.08	±0.99	±0.72	±0.96	±0.61

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (12) Mean corpuscular hemoglobin (pg) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	12h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R	25.30	24.01	23.19	23.49	24.78	25.86	26.33	24.34	24.97	23.115	23.116	23.001	21.24	22.46	22.70	22.76	24.38	24.66	25.556	23.87	21.170	21.116	22.14	21.14
	SD	±1.22	±1.97	±2.14	±2.89	±2.57	±3.13	±3.80	±1.49	±.67	±1.48	±1.54	±1.57	±3.64	±2.38	±2.44	±2.36	±1.17	±0.36	±0.82	±1.42	.	.	.	.
II*	R	27.19	23.28	23.51	23.94	25.83	27.29	27.25	26.92	25.887	24.881	24.51	24.110	24.95	25.36	24.26	24.00	22.33	22.73	23.221	23.71	22.251	22.230	22.57	22.84
	SD	±0.91	±0.83	±1.40	±0.70	±2.71	±2.64	±3.77	±2.39	±2.96	±2.51	±3.48	±2.29	±1.30	±1.59	±2.21	±1.93	±2.82	±1.40	±0.88	±1.20	.	.	.	.
III*	R	24.38	23.44	23.65	28.43	26.69	29.29	28.14	27.54	28.722	27.882	28.668	25.933	24.59	25.02	25.111	25.61	26.111	26.54	27.110	26.83	25.228	24.666	24.64	24.44
	SD	±1.08	±1.19	±2.43	±5.63	±4.17	±7.72	±6.65	±5.65	±5.08	±4.26	±2.80	±1.52	±1.71	±2.20	±1.74	±0.54	±1.50	±72.08	±2.82	±2.55	.	.	.	.
IV	R	26.14	26.07	25.78	25.87	25.85	26.26	25.77	25.70	25.664	25.555	25.667	25.700	26.23	25.94	26.110	26.20	26.10	26.02	25.997	26.03	26.300	26.009	25.73	26.01
	SD	±1.59	±1.53	±1.44	±1.59	±1.30	±1.42	±0.84	±1.19	±1.211	±1.226	±1.225	±1.337	±1.65	±1.53	±1.52	±1.48	±1.68	±1.37	±1.334	±1.59	±1.338	±1.449	±1.32	±1.34

h; hour, d; day, R; rate, SD; standard, *; significant important (P<0.05)

Table (13) Mean corpuscular hemoglobin concentration (g\ dL) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I	R	39.80	37.8	37.24	36.68	39.42	40.24	39.88	37.48	38.77	37.95	37.92	37.02	34.80	36.23	36.66	36.70	39.40	39.95	41.50	39.20	35.60	33.90	35.10	34.70
	SD	±3.97	±4.81	±2.60	±2.80	±4.42	±4.54	±5.03	±2.19	±3.00	±2.05	±2.43	±2.06	±5.05	±3.86	±3.97	±3.86	±0.84	±0.49	±1.83	±0.70	.	.	.	.
II	R	42.42	39.16	39.16	38.94	40.12	41.36	42.02	41.04	41.40	39.55	39.00	40.25	41.66	43.06	40.93	40.76	38.00	39.00	39.90	40.65	39.00	39.00	38.80	39.000
	SD	±2.207	±0.88	±0.89	±0.55	±0.63	±2.86	±5.054	±2.22	±4.89	±2.42	±4.23	±3.65	±0.55	±0.60	±2.34	±2.53	±5.37	±2.82	±1.41	±1.62	.	.	.	.
III	R	40.160	38.60	39.30	42.24	38.84	42.66	43.12	42.82	45.02	43.55	45.37	43.42	43.63	43.70	44.16	43.30	43.80	42.30	42.45	42.40	40.00	39.30	39.10	38.770
	SD	±1.467	±1.49	±2.82	±5.84	±.84	±4.46	±7.49	±7.26	±9.18	±9.53	±7.63	±6.12	±5.65	±5.57	±5.45	±4.15	±5.37	±4.38	±4.17	±4.24	.	.	.	.
IV	R	42.482	42.52	40.94	40.64	41.32	42.28	43.02	42.60	42.44	42.50	42.72	42.22	42.72	42.80	43.2	42.98	44.64	44.50	44.90	44.86	44.26	44.64	44.22	44.482
	SD	±2.671	±2.04	±2.83	±2.62	±2.81	±2.40	±2.66	±2.33	±2.45	±2.84	±3.04	±2.55	±2.97	±3.21	±3.11	±2.42	±2.89	±3.63	±3.71	±2.47	±2.22	±3.26	±2.96	±2.668

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (14) Total platelets count ($x10^9$ \ L) after endotoxin adminstration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R	0.35	0.14	0.16	0.21	0.28	0.29	0.42	0.35	0.34	0.35	0.35	0.33	0.36	0.35	0.33	0.33	0.38	0.39	0.39	0.40	0.28	0.21	0.27	0.26
	SD	±0.10	±0.07	±0.04	±0.05	±0.08	±0.03	±0.16	±0.12	±0.12	±0.11	±0.15	±c14	±0.18	±0.18	±0.15	±0.14	±0.17	±0.17	±0.16	±0.15	.	.	.	.
II*	R	0.33	0.09	0.17	0.22	0.21	0.24	0.27	0.25	0.28	0.28	0.28	0.29	0.25	0.25	0.26	0.27	0.27	0.28	0.27	0.28	0.33	0.31	0.32	0.32
	SD	±0.05	±0.02	±0.04	±0.04	±0.05	±0.06	±0.007	±0.01	±0.02	±0.05	±0.06	±0.06	±0.04	±0.05	±0.04	±0.03	±0.06	±0.05	±0.03	±0.05	.	.	.	.
III*	R	0.34	0.08	0.15	0.18	0.17	0.20	0.28	0.34	0.26	0.27	0.29	0.26	0.27	0.27	0.27	0.28	0.31	0.34	0.34	0.33	0.34	0.33	0.22	0.26
	SD	±0.07	±0.01	±0.04	±0.06	±0.05	±0.03	±0.07	±0.14	±0.02	±0.06	±0.05	±0.01	±0.04	±0.04	±0.03	±0.02	±0.05	±0.06	±0.3	±0.1	.	.	.	.
IV	R	0.38	0.34	0.34	0.36	0.37	0.36	0.35	0.35	0.36	0.36	0.36	0.33	0.34	0.35	0.36	0.36	0.35	0.36	0.37	0.35	0.35	0.35	0.35	0.35
	SD	±0.01	±0.11	±0.08	±0.10	±0.12	±0.11	±0.06	±0.10	±0.11	±0.07	±0.11	±0.13	±0.13	±0.13	±0.11	±0.13	±0.11	±0.13	±0.15	0.13	±0.14	±0.12	±0.13	±0.13

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important ($P<0.05$)

Table (15) Total plasma proteins values in g/L after endotoxin administration in I, II, III and control groups

Time / Group		0h	1h	6h	2h	24 h	2d	3d	4d	5d	6d	7d	8d	9d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d
I*	R	56.00	61.00	60.40	58.60	61.20	63.40	63.20	61.40	61.00	61.87	61.87	61.50	59.33	59.33	59.00	59.33	61.00	62.50	61.00	65.00	63.00	62.00	65.0	66.00
	SD	±5.43	±3.16	±3.64	±5.6	±4.49	±2.96	±5.54	±5.27	±7.25	±4.87	±5.54	±5.00	±6.42	±5.50	±3.60	±1.15	±1.41	±3.53	±0	±0	.	.	.	.
II*	R	58.10	64.90	62.90	62.20	66.00	67.60	68.00	67.00	67.00	68.25	65.50	63.75	67.33	69.00	68.66	68.00	63.50	67.00	67.50	65.50	69.00	66.00	68.00	67.00
	SD	±4.69	±4.69	±4.98	±1.48	±3.74	±4.09	±4.52	±6.74	±4.76	±4.03	±6.35	±5.67	±6.65	±7.93	±6.35	±6.08	±4.94	±2.82	±3.53	±7.77	.	.	.	.
III*	R	57.60	66.00	64.20	63.80	61.40	67.60	66.10	70.60	68.50	65.50	67.50	68.00	70.33	72.33	68.66	67.66	70.50	68.50	69.50	67.00	66.00	70.00	69.0	68.00
	SD	±4.61	±2.73	±2.77	±2.58	±2.40	±3.04	±5.02	±3.57	±3.41	±2.64	±1.91	±3.16	±4.93	±4.50	±4.50	±2.51	±070	±070	±2.12	±1.41	.	.	.	.
IV	R	58.20	58.40	61.20	62.40	54.60	56.60	56.00	57.00	55.20	55.00	55.60	59.40	58.60	58.40	59.2	59.6	57.20	55.40	56.20	58.80	58.60	57.20	58.8	58.20
	SD	±4.81	±3.97	±1.64	±2.19	±6.54	±6.69	±5.38	±5.04	±4.65	±6.28	±7.12	±6.58	±5.81	±6.50	±6.57	±5.36	±7.25	±5.41	±7.66	±9.60	±7.23	±6.26	± 7.0	± 7.46

h; hour, d; day, R; rate, SD; standard diviasion, *; significant important (P<0.05)

Table (16) Fibrinogen values (g/L) after endotoxin administration in I, II, III and control groups

Time Group		0h	1h	6h	12h	24h	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d	12d	13d	14d	15d	16d	17d	18d	19d	20d
I*	R	1.60	0.70	1.30	2.20	2.00	2.10	1.80	1.80	1.87	2.00	1.75	2.00	1.83	1.83	2.00	1.66	1.75	2.25	2.00	2.00	2.00	2.00	1.50	2.00
	SD	±0.41	±0.27	±0.44	±0.44	±0.35	±0.41	±0.44	±0.27	±0.25	±0	±0.28	±0.40	±0.28	±0.28	±0	±0.28	±0.35	±0.35	±0	±0	.	.	.	.
II*	R	1.70	0.75	2.10	2.10	2.10	1.80	2.10	2.50	1.87	1.50	1.37	1.55	2.00	2.00	2.16	2.33	2.25	1.75	2.00	2.50	1.50	1.50	2.00	2.00
	SD	±0.44	±0.35	±0.65	±0.22	±0.41	±0.83	±0.41	±0.70	±0.25	±0.40	±0.47	±0.61	±0	±0.50	±0.28	±0.57	±0.35	±1.06	±0	±1.41	.	.	.	.
III*	R	1.90	0.70	1.80	2.40	2.14	2.20	2.00	2.20	2.00	1.75	1.50	1.75	1.83	2.16	2.16	1.83	2.75	2.00	2.25	2.50	2.50	2.50	2.00	2.00
	SD	±0.54	±0.27	±0.27	±0.41	±0.35	±0.44	±0.50	±0.44	±0.40	±0.50	±0.40	±0.50	±0.28	±0.28	±0.28	±0.28	±1.06	±0	±0.35	±0	.	.	.	.
IV	R	1.54	1.50	1.80	1.80	1.54	1.60	1.50	1.60	1.90	1.70	1.50	1.50	1.70	1.60	1.80	1.70	1.50	1.74	1.30	1.60	1.60	1.50	1.80	1.70
	SD	±0.50	±0.50	±0.57	±0.44	±0.36	±0.41	±0.35	±0.22	±0.41	±0.44	±0.35	±0.35	±0.27	±0.41	±0.27	±0.27	±0.35	±0.25	±0.27	±0.22	±0.22	±0.35	±0.27	±0.44

H: hour, d: day, R: rate, SD: standard diviasion, *; significant important (P<0.05)

دراسة التغيرات الدمية للذيفان الداخلي لجراثيم السالمونيللا الجرذانية (*Salmonella typhimurium*) في الارانب

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الخلاصة

أن للذيفان الداخلي تاثيرًا واسعاً على مختلف أجهزة الجسم ، لذا أعدت هذه الدراسة لمعرفة تأثيره الدمي وذلك باستخدام عشرين أرنباً وزعت عشوائياً على أربعة مجاميع متساوية ، وأعطيت بالحقن الوريدي الذيفان الداخلي بجرع 5 و 15 و 20 مايكروغم/كغم من وزن الجسم للمجاميع الاولى والثانية والثالثة ، أما المجموعة الرابعة فقد أعطيت محلول الدارىء الفوسفاتي لتكون مجموعة سيطرة

ظهر بعد حقن الذيفان الداخلي قلة واضحة لكريات الدم البيض نتيجة للقلة الواضحة للعدلات ، تبع ذلك زيادة الكريات البيض والذي تميز بزيادة الخلايا اللمفية والوحيدة والقاعدية ، أما عد الحمر الكلي والحجم الخلوي المرصوص وتركيز خضاب الدم كانت عالية خلال الساعة الاولى ، بعدها أتبع بقلة في هذه المعايير مما أدى الى تطور فقر الدم والذي هو من نوع الخلايا الكبيرة – قليلة الصباغ، كذلك لوحظ قلة الصفيحات الدموية، وسجل قيمة بروتين البلازما الكلي ومنشأ الليفين والتي كانت واضحة الزيادة .

REFERENCES

1-Parrillo, J.E. (1993) Pathogenetic mechanisms of septic shock. *N. Engl. J. Med*.328 (20): 1471-1478.

2-Numata, M. ; Suzuki,S. ; Miyazawa,N. ; Miyashita,A. ; Nagashima,Y.; Inoue, S.; Kaneko, T. ; and Okubo, T. (1998) Inhibition of inducible nitric oxide synthase prevents LPS induced acute lung injury in dogs. *J. Immun*., 160: 3031-3037.

3-Burrows, G.E. (1970) Endotoxemia induced by rapid intravenous injection of *Escherichia coli* in anesthetized Ponies. *A.J.V.R.*, 31 (11):1967-1973.

4-Dekkers, P.E.P; Hove, T.; Velde, A.A.; Deventer, S.J.H. and Poll, T. (2000) Upregulation of monocyte urokinase plasminogen activator receptor during human endotoxemia. *Infect. Immun.*, 68(4): 2156-2160.

5-Nagraja, T. G. ; Bartly, E. E. ; Anthony, H. D. ; Leipold, H. W. and Fina, L. R. (1979) Endotoxin in calves from intravenous injection of rumen bacterial endotoxin .*J. Anim .Sci*. 49 (2): 567-582.

6-Abraham, E.; Arcaroli, J. and Shenkar, R. (2001) Activation of extracellular signal-regulated Kinases, NF-□B, and cyclic adenosine 5'-monophosphate response element-binding protein in lung neutrophils occurs by differing mechanisms after hemorrhage or endotoxemia. *Jour. Immunol.*, 166: 522-530.

7-Gertsen, K.E. (1970) Endotoxic shock in the horse. *Proc.Am.Ass.Equine Pract*. 16:309-320.

8-Tennant, B.; Reina-Guera, M. and Harrold, D. (1973) Metabolic Response of Calves following Acut Experimental Endotoxemia. *Ann.Rech.veter*. 4(1):135-147.

9-Ogata, H.; Mishio, M.; Luo, X. X. and Xu, X. (1996) Significance of elevated cytochrome aa3 in a state of endotoxemia in dogs. *Resuscitation*. 33(1): 63-68.

10-Uchiba, M. ; Okajima, K. ; Murakami, K. ; Johno,M. ; Mohri,M. ; Okabe,H. and Takatsuki, K. (1997) rhs-TM prevents ET-induced increase in pulmonary vascular permeability through protein C activation .*Am. J. Physiol. Lung Cell Mol. Physiol.* 273: 889-894.

11-Schalm, O.M.; Jain, N.C. and Carroll, E.J. (1975) Veterinary hematology. 3rd Ed. *Lea and Febiger. Philadephia, USA*. 807p.

12-Coles, E.H. (1986) Veterinary Clinical Pathology .4th Ed., *W.B.Saunders Co. USA*.486p

13 Lechner, A.J.; Velasquez, A.; Knudsen,K.R.; Johanns,C.A.; Thomas,F.; Tracy, J. and Matuschak,G.M. (1998) Cholestatic liver injury increases circulating TNF-ά and IL-6 and mortality after *Escherichia coli* endotoxemia .*Am. J. Respir. Crit. Care Med.*, 157(5): 1550-1558

14-Mackay, R.J. (2002) Endotoxemia .In: Smith, B.P. Large Animal Internal Medicine 3rd Ed. *Mosby-Year Book, London*. pp:733-749.

15-Haen, P.J. (1995) Principles of hematology. *Wm.C.Brown, London*. 455p.

16-Otterbein, L. ; Chin, B.Y. ; Otterbein, S. L. ; Lowe, V. C. ; Fessler, H. E. and Choi, A. M. (1997) Mechanism of hemoglobin-induced protection against endotoxemia in rats: a ferritin-independent pathway.*Am.J.Physiol*.272(2): 268-275.

17-Feldman, B.F.; Zinkl, J.G. and Jain, N.C. (2000) Schalm´s veterinary hematology.5th Ed. *Lipppincott Williams and Wilkins, London.*1850 p

18-Rubin , R. H. and Weinstein , L. (1977) Salmonellosis : Microbiological , pathological and clinical features. *Stratton Intercontinental Medical book corporation, New York*. pp: 5-49.

19-Kyriakis, J. M. and Avruch, j. (1996) Sounding the alarm: protein kinase cascades activated by stress and inflammation . J. Biol. Chem., 271(40): 24313-24316

20-Minter, R.M. ; Fan,M.H. ; Sun,J. ; Niederbichler, A. ; Ipaktchi,K. ; Arbabi, S. ; Hemmila, M.R. ;Remick,D.G. ;Wang,S.C. and Su,G.L. (2005) Altered kupffer cell function in biliary obstruction.