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IMMUNOPARASITOLOGICAL STUDY IN BILHARZIAL PATIENTS WITH OR WITHOUT HEPATITIS C VIRUS IN EL-BEHEIRA GOVERNORATE

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ABSTRACT: Hepatitis C virus infection and schistosomiasis are common in Egypt. Coinfection is not uncommon. Little and quite controversial data are known about biochemical profile in these patients. This study was designed to study IL-2 production as a marker of lymphocyte activity in patients suffering from schistosomiasis with or without hepatitis C virus infection. This work enrolled 513 patients (239 females and 274 males) of Damanhour Teaching Hospital. Study sample included 120 subjects to form 4 groups: gp I (30 normal subjects as control), gp II (30 patients +ve for *S. mansoni* only), gp III (30 patients seopositive for HCV only), and gp IV (30 patients with mixed *S. mansoni* and HCV infection). The intensity of schistosomiasis was estimated by Kato-Katz technique. ELISA was used to detect anti HCV, HBs Ag and to estimate interleukin 2 (IL 2) in serum of selected groups. Indirect haemagglutination test was used to detect schistosomiasis among pure HCV. Complete blood picture and liver function tests were also done. Out of 513 samples examined, 89 (17.3%) were +ve for *Schistosoma mansoni* and 7 (1.4%) +ve for *Schistosoma heamatobium*. The overall prevalence rate among males was almost double that among females (21.9% versus 12.1%). The risk of HCV infection increased 7 times with the presence of *S. mansoni* infection. Focusing on the risk factors for *S. mansoni* infection it was found that gender, water contact, low education, and low socioeconomic status were the most important factors affecting prevalence of *S. mansoni* infection which in turn increased the risk of HCV infection. In the selected studied groups the results of heamatological and biochemical parameters showed significant decrease in group IV (schistosomiasis + HCV) than that of normal controls, schistosomal, and HCV patients groups. On the other hand, there were an increase in serum bilirubin and aminotransferase enzymes in the group of mixed infections. It has been shown that, in patients with mixed infections, IL2 level was lower than that of the other 3 groups. In conclusion *S. mansoni* was the predominating species in the present study. History of water contact, low education, and low socioeconomic status were the most important determinant factors of schistosomiasis. The risk of HCV infection increased with the presence of schistosomiasis.

INTRODUCTION

Schistosomiasis is still endemic in 74 tropical and subtropical countries. It ranks second behind malaria in terms of socio-economic and public health importance. Despite control efforts in a number of countries, still an

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estimated 200 million people are infected and about 600 million are at risk.[1] WHO reported that 120 million are symptomatic and 20 million have severe consequences of the infection.[2]

In Egypt, the total number of infected individuals with schistosomiasis are in the range of 5-6 million which means that Egypt is one of the most highly endemic areas in the world[3]. The prevalence of *S. mansoni* ranged between 17.5% to 42.9% among both sexes aged 5-50 years in El-Behira Governorate.[4,5]

Hepatitis C virus infection is a global health problem. WHO estimates that 3% of the world's population has been infected with HCV and that more than 170 million persons are chronic carriers.[6] Recently, HCV infection was concluded to be the main cause of chronic liver diseases in Egypt, where this infection is largely associated with schistosomiasis which has been claimed to be an important risk factor for HCV infection[7]. However, The immunologic aspects of this pattern of coninfection have never been reported because of the absence of small animal model that can support both infections[8]. A cytokine (IL2), is one of the peptide mediators which up and down regulate immunologic, inflammatory, and reparative host responses to injury.[9] T-helper lymphocytes are separated into T-helper 1 (Th1) and T-helper 2 (Th2) cells depending on their cytokine secretion pattern. Th1 cytokines; (interferon γ (IFN-γ), IL2, and tumour necrosis factor) promote cellular immune responses. Th2 cytokines (IL-4, IL-5, IL-6, and IL-10) regulate the humoral immune responses. Cytokines produced by each subset inhibit the production and activities of the opposing subset.

The type of T-helper cell that predominates in a parasitic infection influences the course of the disease.[10] Although concomitant schistosomiasis and HCV infection is common in Egypt and other developing countries, yet little information is available on the immunological factors that may be affected due to pathogenesis of these diseases[11,12]. However, this pattern of viral/parasitic coinfection offers a unique opportunity to study the evolution and kinetics of human immune responses toward HCV in a setting of prevailing Th_2 immune response.[8]

The aim of the present work was to determine the prevalence of schistosomiasis and hepatitis C virus among out- and in-patients of Damanhour Teaching Hospital in El-Beheira Governorate, to study (IL-2) production as a marker of lymphocyte activity in patients suffering from schistosomiasis with or without hepatitis C virus infection.

MATERIAL AND METHODS

The cross sectional study was carried out among out- and in-patients attending Internal Medicine Department of Damnhour Teaching Hospital in El-Behira Governorate. Study population included 513 patients; 239 females and 274 males. Their age ranged from 3-63 years.

Data Collection

All the study population enrolled in the present study were subjected to the following:-

a- A specially designed questionnaire was filled for every patient. Personal, demographic, and socioeconomic data were collected, including profession, e.g., farming, fishing,…, etc., the use of canal water in

washing, bathing.

b- Laboratory investigation

1. Stool samples were collected in clean tight proof plastic containers. Samples were processed using:

- Formol ether sedimentation technique to detect intestinal helminthes.[9]
- Kato Katz technique was also applied to estimate Intensity of infection of *S. mansoni*.[13]

2. Urine samples: were collected in plastic bottles to diagnose *S. haematobium* infection.[14]
3. Blood samples were collected, centrifuged, sera separated, and stored at -20°C until tested for:

- Schistosoma antibody using IHA[15].
- HBs Ag[16].
- Anti ^{HCV} using 3rd generation ELISA technique.[17]

Based upon stool analysis, a total of 513 screening patients, enrolled in this study were divided into 3 categories:

- The first includes 89 *S. mansoni* cases. Two groups (II and IV) were selected from this category.
- The second and third include 232 patients who had parasitic infections other than *S. mansoni* and 192 free (negative) of parasitic infection respectively. The other two groups (I and III) were selected from these 2 categories. Identification and selection of the four studied groups based upon serological tests were done as follows:

GP I: Included 30 healthy persons served as control group (matching in age, sex, and socioeconomic status).

GPII: Included 30 patients +ve for *S. mansoni* only and seronegative for HBsAg and anti-HCV.

GPIII: Included 30 patients seropositive for anti-HCV and -ve HBsAg and schistosomiasis infection.

GP IV: Included 30 patients with mixed *S. mansoni* and HCV infections and negative for HBsAg.

All selected cases were subjected to the following:-

1. Taking detailed medical history, (e.g., history about schistosomiasis, infections with HBV and/or HCV, and drugs used for schistosomiasis and other liver diseases).
2. Full clinical examination with special attention to signs of jaundice, fever, hepatomegally, spleenomegally, and other liver disease.
3. Complete blood picture[18].
4. Liver function tests including biochemical investigations ALT, AST, serum total bilirubin, plasma prothrombin activity, total protein, and albumin[19].
5. Estimation (quantitative determination) of interleukin-2 (IL-2) in serum by ELISA technique[20].

Statistical Analysis

Data collected were coded, tabulated, and analyzed using SPSS software package version 10 to compare the risk of schistosomiasis and hepatitis virus infection among groups, Chi-square was used to study the association between two qualitative variables. A one-way analysis of variance (ANOVA) was used for comparison between more than 2 groups of means. Odds ratio together with its 95% confidence interval were used.

RESULTS

Table (1) shows the percentages of infection with helminthes among the studied population. Intestinal parasites were detected in 62.6% of the examined

patients. *E. vermiculares* ranked the 1st (20.1%), followed by *A. lumbricoides* (16.2%), *Trichuris trichiura* (14.8%) and *H. nana* (13.1%). *H. heterophys*, *S. stercoralis*, *A. duodenale* and *Fasciola* species were less frequent (1.2%, 1.0%, 0.8%, and 0.6%, respectively).

The overall percentage of schistosomiasis was (18.7%) (*S. mansoni* (17.3%) and *S. haematobium* (1.4%)).

Table (2) shows the distribution of *S. mansoni* infection and intensity of eggs in stool according to age and sex. The overall prevalence of *S. mansoni* infection among the studied sample was 17.3% with intensity of 54.2 eggs/gram as measured by GMEC.

S. mansoni was detected among all age groups; however, children below the age of 5 had the lowest prevalence. The peak prevalence and intensity of infection were found among age group of 10-<15 years.

Infection according to sex revealed that males showed higher

S. mansoni infection rates (21.9%) than females (12.1%) in all age groups and higher intensity of infection. Differences were statistically significant.

The risk factors that were significantly associated with *S. mansoni* infection were history of canal water contact, history of prior anti-schistosomal treatment, and history of blood in stools of the patients and lower educational levels. Occurrence of *S. mansoni* infection increased with lower income groups and higher crowding index, Table (3)

The impact of schistosomiasis on the risk of HCV infection is presented in Table (4) as all subjects of the studied groups (I-IV) were –ve for HBs Ag the

risk of HCV infection increased with presence of *S. mansoni* infection (41.8%) compared to 9.9% among those negative to *S. mansoni* infection. The difference was statistically significant.

In the selected studied groups (I-IV) the results of hematological, biochemical, and immunological parameters revealed that:-

Significant decrease in blood Hb level was found in *S. mansoni* associated with HCV patients (group IV) compared with that of healthy controls (group I) and in HCV patients (group III). The same pattern has been observed as regards RBCs, WBCs, lymphocytic, and platelets counts, (Table 5).

As regard biochemical findings, Table (6) reveals that the levels of total protein, serum albumin, and plasma prothrombin activity were significantly decreased in mixed infection when compared to the other three groups. Whilst total serum bilirubin level and ALT were increased in mixed infection when compared to HCV group on the other hands there was statistically significant increase in AST serum level in groups II and III when compared to group IV (mixed infection).

Table (7) shows significant decrease in IL-2 level in all groups compared to healthy control (group I). Furthermore, a significant decrease in this level has been observed in group IV when compared to group II and group III.

A significant moderate positive correlation has been observed in Table (8) between IL-2 and lymphocytic count, platelets count, and prothrombin activity. Moreover, weak positive correlation has been observed between IL-2 and haemoglobin and WBCs.

DISCUSSION

Schistosomiases continue to be a

major public health problem especially as a risk factor for HCV and chronic liver diseases.[21] In Egypt, many investigators have documented a high prevalence of schistosoma infection in rural areas population.[22,23] HCV represents a health problem affecting an estimated 170 million people world wide and 10%-31% of the population in some countries, such as Egypt.[24,25]

The present study was designed to study the immune status of the patients suffering from schistosomiasis with and without HCV in El-Beheira Governorate which is considered as one of the highly endemic areas for schistomiasis.

It was observed that bad sanitary conditions stand beyond the existing high rate of helminthic infection among rural population. Thus, communities with basic amenities of safe water supply, proper sewage and refuse disposal have lower prevalence[26,27] than those with one or none of these amenities.

The overall prevalence and intensity of *S. mansoni* infection among our studied sample were 17.3% and 54 eggs/g respectively. Such prevalence was lower than that reported in Abis VIII village in 2000-2001 which was 37.8% - 48.6%[33,34]. Meanwhile, it is in agreement with other authors[4,5]. Lower prevalence in our study could be explained on the grounds that our studied groups have lower levels of agricultural, recreational, and domestic exposure to canal water.

The present study revealed that children below the age of 5 years had the lowest prevalence.

The peak prevalence and intensity of infection were observed among those aged 10-<15 years. Young children might get infection while accompanying their mothers

to canals for washing utensils or clothes. The prevalence and intensity of infection increases as the children grow and become able to frequent water bodies and by spending a longer time swimming, bathing, and washing. This finding matched with what previously reported in community-based studies in the Nile Delta and Upper Egypt; children particularly, around 10-<15 years, have been associated with the highest prevalence and intensity of *S. mansoni* infection[18,28,29].

In agreement with the present data, the risk of schistosomiasis for males was found to be greater than that for females in the Republic of Yemen. Gray *et al*., 1999[30] suggested that sex difference could be attributed to the role of male in farming.

The current study revealed that individuals exposed to canal water were 4 times at risk of infection compared to non-exposed individuals. This is consistent with what revealed by previous studies[31,32].

In accordance with our results, it has been reported that prior treatment of schistosomiasis was a risk for infection[26,27], meanwhile, the associated risk was statistically significant.

Inspite of the fact that blood in stools is not a direct indicator for intestinal schistosomiasis,[25] the present study revealed that it was frequent symptom among *S. mansoni* infected cases.

On the contrary, there was no association between history of abdominal pain and *S. mansoni* infection which is consistent with what has been stated by Nooman *et al., (*2000)[4].

A significantly higher prevalence of *S. mansoni* infection was found among those with the lower educational level. This was against previous studies[28].

They found that both illiterates and literates had high levels of infection[33,34]. This finding was also confirmed by Abdel-Aty *et al*., (2000)[35] who reported that there was no relation between education and schistosomiasis.

The obtained results indicated that, *S. mansoni* infection rate increased with low income and high crowding index. The significant effect of the income on parasitic infection was reported by Shehata (1995)[34].

Epidemiological studies in Egypt demonstrated that the highest risk of hepatitis C virus (HCV) infection occurred among patients infected with schistosomiasis[36-38]. HCV-antibody prevalence was reported to be 70% in adults suffering from schistosmiasis without a history of blood transfusion[39]. Some authors showed that patients with concomitant HCV and schistosomiasis infection had a higher incidence of cirrhosis and hepatocellular carcinoma (HCC)[40,41].

The obtained results showed that, out of 513 examined, 81 were anti-HCV seropositive with overall prevalence (15.8%), using third generation ELISA test. This prevalence nearly coincides with that reported among Egyptian population where the prevalence of HCV infection was 10%-31%[25,42].

Haemomarkers pattern of the mixed infection (*S. mansoni* associated with HCV) group showed significant decrease compared to the other 3 groups. This has been confirmed and explained by an inverse relationship between cytotoxic T-lymphocytes (CTL) responses and viral load hypothesis.

That HCV-specific CTL limits viral replication but in co-infected patients selective deterioration of HCV specific

Th_1 responses might play a role in progression of HCV disease[43].

Several biochemical parameters were used to assess liver dysfunction. Serum total proteins were significantly lower in the mixed infection (*S. mansoni* with HCV) when compared to healthy control group while in contrast serum bilirubin which showed higher mean values in mixed group than individuals of other three groups. This reflects the impairment of the hepatic synthetic capability.[44] The serum aminotransferases which are indicators of hepatocellular necrosis showed minimal elevation in HCV infection. Kamal *et al*., (2001)[8] stated that ALT levels could not predict the outcome of HCV infection.

The elevation of serum activity levels of amino transferases, ALT and AST are mostly owing to the release of the enzymes from the surrounding liver cells; due to the increasing pressure from the growing mass when integrity of the hepatocytes are compromised. Some reports showed +ve relationship between high levels and advanced liver damage, while other reports failed to prove this relationship[45,46].

As regard immunological change associated with *S. mansoni* with or without HCV infection, the present data showed that, in patients with mixed infections, IL-2 level was lower than that of the other 3 group.

This could be explained by the fact that schistosomiasis down regulates Th1. T-lymphocytes, in turn, reduces serum IL-2 production which is very important for the stimulation of mononuclear cells and fibroblasts to produce IFN-γ which is thought to be involved in the control of the virus.[47]

This is in line with findings of previous reports demonstrating that alterations of cytokine patterns in the form of insufficient intrahepatic Th1 responses or augmented Th2 responses enhance progression of fibrosis[43]. Collectively, Th2 immunologic bias characteristic of *S. mansoni* infection could modulate the outcome and course of HCV infection as $CD4^+$ Th1 responses are associated with either viral clearance of or slower disease progression. On the other hand, none of coinfected patients achieved viral clearance[8].

In conclusion, the data presented in the current study have demonstrated the importance of cellular immune responses in preventing the progression of liver disease and may have implications for development of immunotherapy.

Finally, recent studies illustrated that derangement of certain cytokine genes might make some patients more susceptible to the development of HCC[48].

Table (1): Distribution of helminthic infections among the studied samples

Parasites	Number	%
1-Free cases (No parasite seen)	192	37.4
2-*Schistosoma mansoni*	89	17.3
3-*Schistosoma haematobium*	7	1.4
4-Other parasite infections:		
Enterobius vermicularis	103	20.1
Ascaris lumbricoides	83	16.2
Trichuris trichiura	76	14.8
Hymenolepies nana	67	13.1
Hetrophyes heterophes	6	1.2
Strongyloides stercoralis	5	1.0
Ancylostoma duodenale	4	0.8
Fasciola species	3	0.6
Total positive	321	62.6
Total	513	100.0

Table (2): Distribution of *S. mansoni* infection and intensity of eggs in stool in relation to age and sex

Age (years)	*S. mansoni infection*								Total			
	Male				Female							
	n=281	Infected		GMEC	n=281	Infected		GMEC	n=281	Infected		GMEC
		No.	%			No.	%			No.	%	
<5	13	1	7.7	31.2	9	0	0.0	0	22	1	4.5	50.1
5-	25	4	16.0	61.1	40	2	5.0	54.6	65	6	9.2	61.0
10-<15	67	17	25.4	74.3	40	6	15.0	67.7	107	23	21.5	72.0
15-63	169	38	22.5	60.4	150	21	14.0	48.4	319	59	18.5	47.8
Total	274	60	21.9	66.4	239	29	12.1	52.0	513	89	17.3	54.2

F test = 8.56, $p<0.05$
GMEC = Geometric mean egg count by Kato technique.

Table (3): Results of some potential risk factors affecting the percentage of *S. mansoni* infection.

Potential risk factors	*S. mansoni*			Crude OR (95% CI)
	n=281	+ve	%	
1- History of canal water contact				
No®	122	18	14.8	1.0
Yes	159	71	44.7	4.7 (2.5-8.8)*
2- History of prior anti-bilharzial treatment				
No®	222	46	20.7	1.0
Yes	59	43	72.9	10.3 (5.1-21.0)*
3- History of blood in stool				
No®	249	67	26.9	1.0
Yes	32	22	68.8	6 (2.5-14.4)*
4- History of abdominal pain				
No®	124	32	25.8	1.0
Yes	157	57	36.3	1.6 (0.95-2.84)
5- Presence of latrines inside houses				
No®	84	30	35.7	2.8 (0.9-4.9)
Yes	197	49	24.9	1.0
6- Education level				
Illiterate, read and write	151	54	35.8	2.3 (1.0-5.3)*
Primary and Preparatory	79	25	31.6	1.9 (0.8-4.8)
Secondary and University®	51	10	19.6	1.0
7- Occupations				
Farmers	83	35	42.2	6.8 (1.4-45.7)*
Laborers	71	10	14.1	1.4 (0.25-10.2)
Students	45	18	40.0	5.7 (1.1-40.4)*
Housewife	63	24	38.1	5.2 (1.0-36.0)*
Employers®	19	2	10.5	1.0
8- Income/ capita/ month*				
50	124	55	44.4	2.9 (1.2-6.8)*
100	111	24	21.6	1.0 (0.4-2.5)
150+ ®	46	10	21.7	1.0
9- Crowding index				
Low	63	11	17.5	1.0
Middle	131	31	23.7	1.5 (0.6-3.4)
High	87	47	54.0	5.6 (2.4-13.0)*

® = Reference group, OR = Odd ratio, CI = confidence intervals, *p <0.05

Table (4): Distribution of anti-HCV seropositivity according to S. mansoni infection using ELISA technique.

Anti-HCV in serum	*S. mansoni* infection				Total	
	+ve		-ve			
	No.	%	No.	%	No.	%
+ve	39	41.8	42	9.9	81	15.8
-ve	50	56.2	382	90.1	432	84.2
Total	89	100.0	424	100.0	513	100.0
Crude OR (95% CI)	OR = 7.1 (4.1-12.4)*		$\chi 2 = 63.51, p<0.05$			

® = Reference group
OR = Odds ratio
CI= Confidence interval

Table (5): Heamatological finding among the studied four groups

Heamatological finding	Studied group				Comparison ANOVA	Significant P<0.05
	Control gp-I	*S.mansoni* gp-II	HCV gp-III	*S. mansoni* + anti HCV gp-IV		
	n=30	n=30	n=30	n=30		
Hb (g/dl)						
Range	14.8-17.6	10.5-16.0	11.3-16.0	8.4-13.6	GPI# GPII	NS
					GPI# GPIII	NS
Mean	15.3	13.2	13.4	11.2	GPI# GPIV	0.0041
±SD	1.61	2.74	1.21	1.72	GPII# GPIII	NS
					GPII# GPIV	NS
					GPIII# GPIV	0.0012
RBCs (million/µl)						
Range	5.0-6.1	4.0-5.5	3.9-5.2	2.9-4.6	GPI# GPII	NS
Mean	5.2	4.4	4.5	3.1	GPI# GPIII	NS
±SD	0.25	0.26	0.25	0.35	GPI# GPIV	0.0001
					GPII# GPIII	NS
					GPII# GPIV	0.0220
					GPIII# GPIV	0.0306
WBCs (count/µ1)						
Range	4600-6400	3500-5370	3400-6000	2100-4100	GPI# GPII	NS
					GPI# GPIII	NS
Mean	4920	4200	4000	2300	GPI# GPIV	0.0012
±SD	454	654	562	920	GPII# GPIII	NS
					GPII# GPIV	0.0110
					GPIII# GPIV	0.0401
Lymphocytic cell count (%)						
Range	33-44	28-39	18-31	14-23	GPI# GPII	NS
Mean	37	31	20	17	GPI# GPIII	0.0420
±SD	3.81	4.24	5.73	6.84	GPI# GPIV	0.001
					GPII# GPIII	0.043
					GPII# GPIV	0.011
					GPIII# GPIV	NS
Platelets (count/µl)						
Range	290-367	259-311.4	231-286	139.2-197.6	GPI# GPII	NS
Mean	341.5	280.8	253.4	149.1	GPI# GPIII	0.036
±SD	59.4	77.5	106.7	131.1	GPI# GPIV	0.010
					GPII# GPIII	NS
					GPII# GPIV	0.026
					GPIII# GPIV	0.020

NS = insignificant
ANOVA = for the comparison between patients studied groups against healthy control group
P= probability value for the comparison between the studied groups against healthy control group

Table (6): Findings of biochemical parameters among the studied four groups

Biochemical parameters in serum	Studied group				Comparison ANOVA	Significant P<0.05
	Control gp-I	*S. mansoni* gp-II	HCV gp-III	*S. mansoni* + anti HCV gp-IV		
	n=30	n=30	n=30	n=30		
Total protein (g/dl)					GPI# GPII	NS
Range	6.8-8.1	6.1-7.7	6.0-7.4	4.8-6.5	GPI# GPIII	NS
Mean	15.3	13.2	13.4	11.2	GPI# GPIV	0.034
±SD	1.61	2.74	1.21	1.72	GPII# GPIII	NS
					GPII# GPIV	NS
					GPIII# GPIV	NS
Albumin (g/dl)					GPI# GPII	NS
Range	4.0-4.9	3.9-4.7	3.4-4.2	2.0-4.0	GPI# GPIII	NS
Mean	4.5	4.1	3.8	2.6	GPI# GPIV	0.0001
±SD	0.37	0.43	0.69	0.85	GPII# GPIII	NS
					GPII# GPIV	0.0321
					GPIII# GPIV	0.0401
Total bilirubin (mg/dl)					GPI# GPII	0.0230
Range	0.4-0.9	0.3-3.1	0.4-3.4	0.5-6.1	GPI# GPIII	0.0102
Mean	0.62	1.19	1.83	3.41	GPI# GPIV	0.0001
±SD	0.15	1.04	0.91	2.87	GPII# GPIII	NS
					GPII# GPIV	0.0001
					GPIII# GPIV	0.0261
ALT (U/L)					GPI# GPII	0.0011
Range	12-36	8-389	14-419	11-192	GPI# GPIII	0.0101
Mean	22.46	75.70	127.33	64.45	GPI# GPIV	0.0020
±SD	6.62	88.07	109.11	50.55	GPII# GPIII	0.0422
					GPII# GPIV	NS
					GPIII# GPIV	0.0204
AST (U/L)					GPI# GPII	0.0002
Range	13-30	12-180	15-230	10-252	GPI# GPIII	0.0031
Mean	20.23	81.30	98.22	58.91	GPI# GPIV	0.0061
±SD	5.42	30.27	62.54	66.54	GPII# GPIII	NS
					GPII# GPIV	0.0435
					GPIII# GPIV	0.0411
Prothrombin activity (%)					GPI# GPII	0.0002
					GPI# GPIII	0.0031
Range	88-100	75-100	60-100	40-90	GPI# GPIV	0.0061
Mean	96	80	76	44	GPII# GPIII	NS
±SD	4.4	7.8	9.8	11.0	GPII# GPIV	0.0435
					GPIII# GPIV	0.0411

NS = insignificant
ANOVA = for the comparison between patients studied groups against healthy control group

Table (7): Distribution of serum IL-2 levels in the four studied groups

IL-2 level # (pg/ml)	Studied groups				Comparison ANOVA	Significant p<0.05
	Control gp-I	*S. mansoni* gp-II	HCV gp-III	*S. mansoni* + anti HCV gp-IV		
Range	0.4-1.2	0.1-0.8	0.1-0.5	0.07-0.3	GpI # GpII GpI # GpIII GpI # GpIV GpII # GpIII GpII # GpIV GpII # GpIV	0.0311 0.0020 0.0001 0.0020 00005 0.0440
Mean ±S.D.	0.75 0.28	0.48 0.16	0.25 0.12	0.14 0.10		

# values are expressed as pg/ml interleukin-2 = IL-2
ANOVA = for the comparison between patients studied groups against healthy control group.

Table (8): Correlation coefficient between IL-2 and different studied parameters.

Interleukin-2	r	p value
Haemoglobin	0.48	0.012*
RBCs count	0.21	0.132
WBCs count	0.41	0.016*
Lymphocytes count	0.65	0.015•
Platelets count	0.60	0.002•
Total serum protein	0.13	0.125
Serum albumin	0.21	0.141
Total serum bilirubin	-0.32	0.109
ALT	-0.51	0.011*
AST	-0.22	0.19
Prothrombin activity	0.69	0.001•

•Moderate positive correlation.
*Weak positive correlation.

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