RESULTS

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The following results were obtained:

1) In the first group of bacterial meningitis, there were:

1- The total leukocytic count showed a mean ± SD of 17875 ± 2276 cells/mm^3.

2- The differential count showed a mean ± SD of 77.8% ± 2.8 neutrophils and 22.2% ± 2.8 lymphocytes.

3- The mean number ± SD of leukocytes in CSF was 1225 ± 738 cells/mm^3 mainly polymorphnuclear leukocytes.

4- Protein concentration was of a mean ± SD of 137.8 ± 24.6 mg/dl.

5- The mean ± SD of glucose level was 10.3 ± 5.3 mg/dl.

6- Bacterial culture of CSF yielded Streptococcus pneumoniae in 15 patients and Neisseria meningitidis in 1 patient.

7- The levels of IL-10 were:

a) In CSF: IL-10 was detected in all CSF samples (16). The median was 275.2 pg/ml ranged between 12.9 - 899.1 pg/ml. The mean ± SD was 338.8 ± 320 pg/ml.

b) In serum: IL-10 was detected in 14 out of 16 serum samples. The median was 26.4 pg/ml ranged between 14.9 - 118.5 pg/ml. Mean ± SD was 41.4 ± 33.2.

8- The levels of TNFα were:

a) In CSF: TNFα was detected in all CSF samples (16). The median was 148.1 pg/ml ranged between 23 - 1832 pg/ml. Mean ± SD was 717.8 ± 796.2 pg/ml.

b) In serum: TNFα was detected in all serum samples (16). The median was 37 pg/ml ranged between 11.6 - 789 pg/ml. Mean ± SD was 100.7 ± 151.8 pg/ml.

2- In the second group of viral meningitis there were:

1- The total leukocytic count showed a mean ± SD of 9933 ± 1032 cells/mm^3.

2- The differential count showed a mean ± SD of 77.3% ± 2.4 lymphocytes and 22.7% ± 2.4 neutrophil.

3- The mean number ± SD of leukocytes in CSF was 273.2 ± 143 cells/mm^3 mainly lymphocytes.

4- The mean ± SD of protein concentration was 62 ± 6.7 mg/dl.

5- The mean ± SD of glucose level was 58.8 ± 5.2 mg/di.

6- Bacterial cultures and Gram stains of CSF were negative for any bacteria.

7- The levels of IL-10 were:

a- In CSF: IL-10 was detected in (8) out of (15) CSF samples, the median was 18.8 pg/ml ranged between 11.6 - 45.1 pg/ml, mean ± SD was 22.05 ± 11.6 pg/ml.

b- In serum IL-10: IL-10 was detected in (5) out of (15) CSF samples, the median was 14.7 pg/ml ranged between 11.2 - 19.8 pg/ml, mean ± SD was 14.8 ± 3.2 pg/ml.

8- The levels of TNFα were:

a- In CSF: TNFα was detected in (4) out of (15) CSF samples, the median was 45.5 pg/ml ranged between 11.2 - 384 pg/ml.

b- In serum: TNF-α was detected only in 2 samples they were 17.2 and 25 pg/ml. The median was 21.1 pg/ml.

3- In the group of control cases there were:

1- The total leukocytic count showed a mean ± SD of 8400 ± 1837 cells/mm^3.

2- The differential count showed a mean ± SD of 46.5% ± 8.1 neutrophils and 53.5% ± 8.1 lymphocytes.

3- There was no detectable leukocytes in all CSF samples.

4- The mean ± SD of protein concentration was 30 ± 6.6 mg/dl.

5- The mean ± SD of glucose level was 60 ± 6.6 mg/dl.

6- Bacterial cultures and Gram stains of CSF were negative for any bacteria.

7- The levels of IL-10 were:

a- In CSF: the level of IL-10 in all CSF samples (10) was below the detectable limit (10.6 pg/ml). The median was 4.2 pg/ml ranged between 1.1 - 7.3 pg/ml. The mean ± SD was 4 ± 2.2 pg/ml.

b- In serum: the level of IL-10 in all serum samples (10) was below the detectable limit (10.2 pg/ml). The median was 3.1 pg/ml ranged between 0 - 7.2 pg/ml. The mean ± SD was 3.3 ± 2.3 pg/ml.

8- The levels of TNFα were:

a- In CSF: the level of TNFα in all CSF samples (10) was below the detectable limit (5.8 pg/ml). The median was 1.8 pg/ml ranged between 0 - 3.7 pg/ml. The mean ± SD was 1.9 ± 1.3 pg/ml.

b- In serum: the level of TNFα in all serum samples (10) was below the detection limit (5.7 pg/ml). The median was 3.2 pg/ml ranged between 1.9 - 4.2 pg/ml. Mean ± SD was 3 ± 0.9 pg/ml.

Statistical analysis listed from table 2 to table 15.

Table (2): Comparison between bacterial meningitis, viral meningitis and control groups regarding age and sex distribution.

	Bacterial $\bar{X} \pm SD$	Viral $\bar{X} \pm SD$	Control $\bar{X} \pm SD$	t	P
Age (in years)	6.3 ± 5.3	6.1 ± 4.8	4.9 ± 3	0.85	> 0.05
Sex :				X^2	P
Male	7	10	3	3.4	> 0.05
Female	9	5	7		
Total	16	15	10		

t : t-test

X^2 : Chi-square test

$\bar{X}$: Mean

The age distribution in group 1 (bacterial broup) ranged between 3 months and 14 years with a mean of 6.3±5.3 years.

In viral group, the age ranged between 3 months and 13 years with a mean of 6.1 ± 4.8 years.

In control group the age ranged between 5 months and 14 years with a mean of 4.9±3 years.

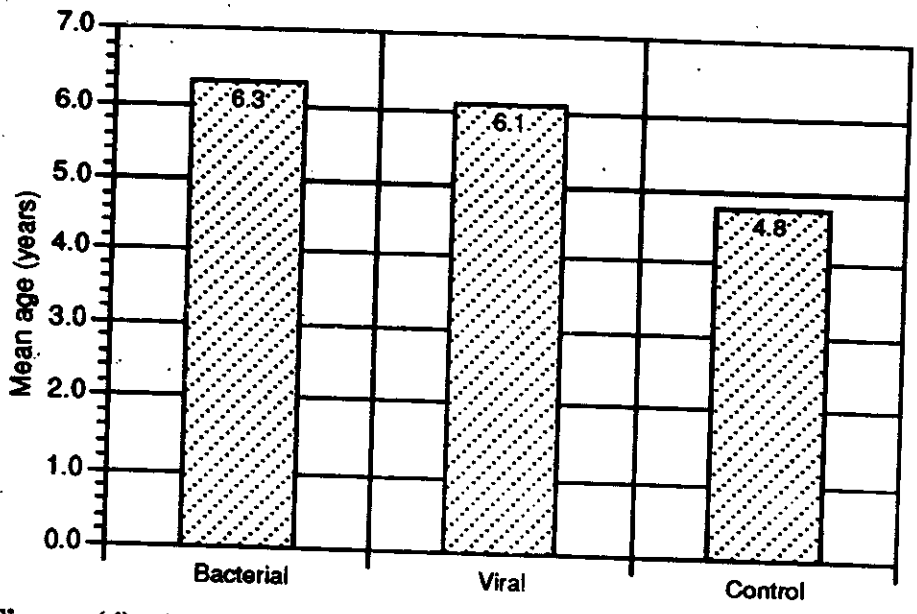

Figure (4): Age distribution in different studied groups.

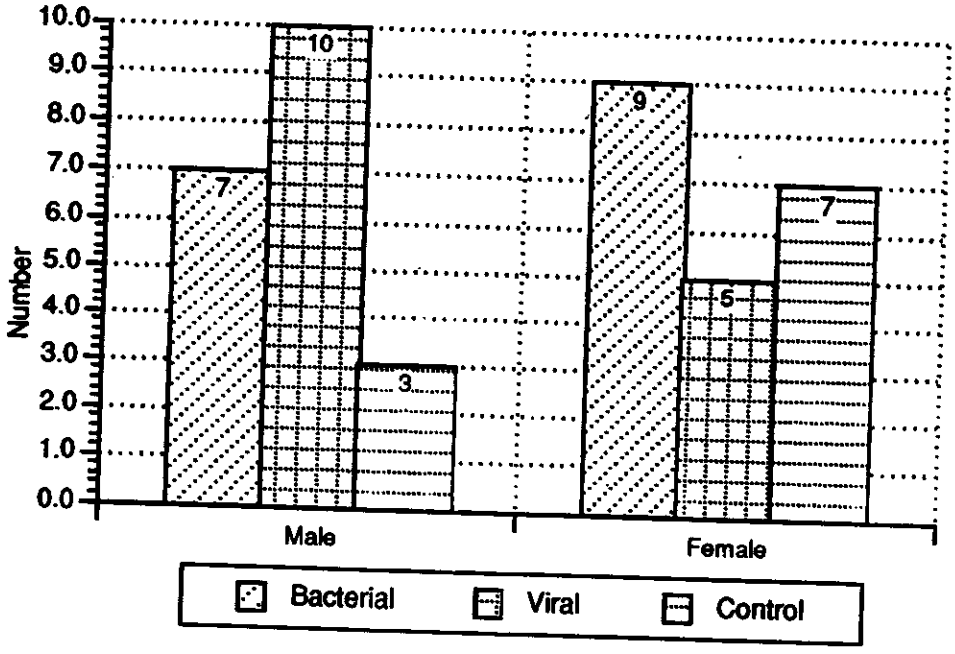

Figure (5): Sex distribution in different studied groups.

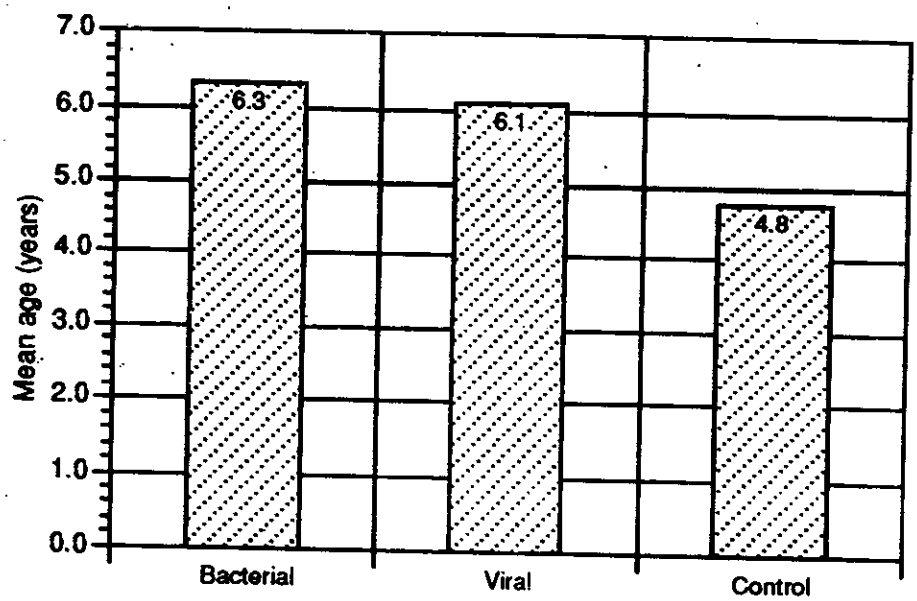

Figure (4): Age distribution in different studied groups.

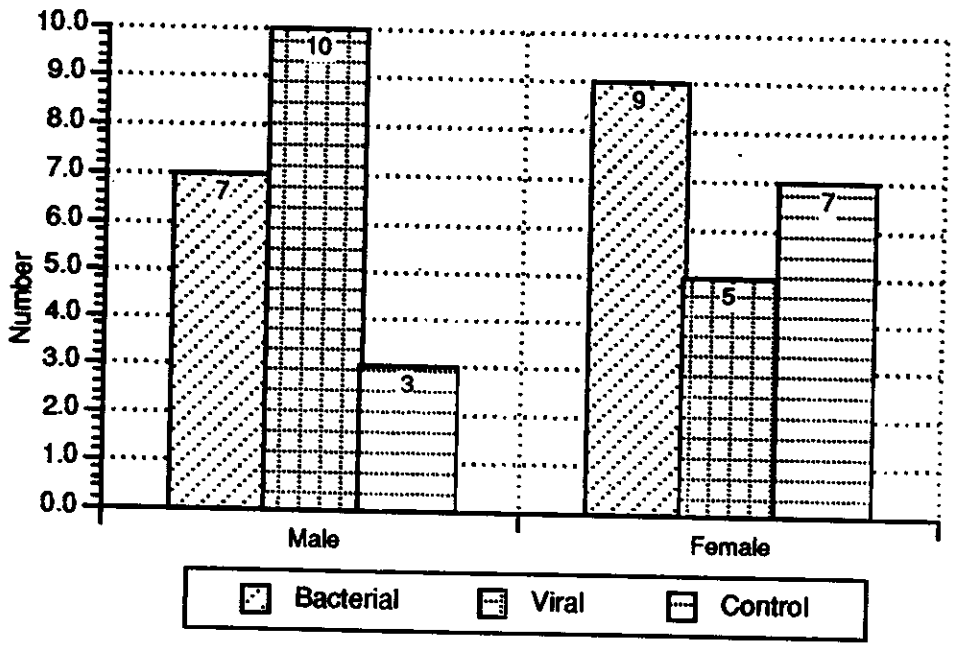

Figure (5): Sex distribution in different studied groups.

Table (3): Comparison between bacterial and viral groups of meningitis regarding symptoms and signs distribution.

Symptoms and Signs	Bacterial meningitis (16)	Viral meningitis (15)	X^2	P
Fever	16	15	–	–
Irritability	4	8	2.5	> 0.05
Vomiting	4	11	7.01	< 0.05
Coma	9	0	11.5	< 0.05
Convulsions	5	7	0.75	> 0.05
Neck rigidity	9	7	0.28	> 0.05
+ve Kernig's sign	6	7	2.6	> 0.05
+ve Brudzinski's sign	5	8	1.5	> 0.05
Bulging fontanel	5	4	0.08	> 0.05

X^2 = Chi-square test

Symptoms and signs were more or less similar except vomiting which was significantly higher in viral cases and coma which was significantly higher in bacterial cases as shown in table (3).

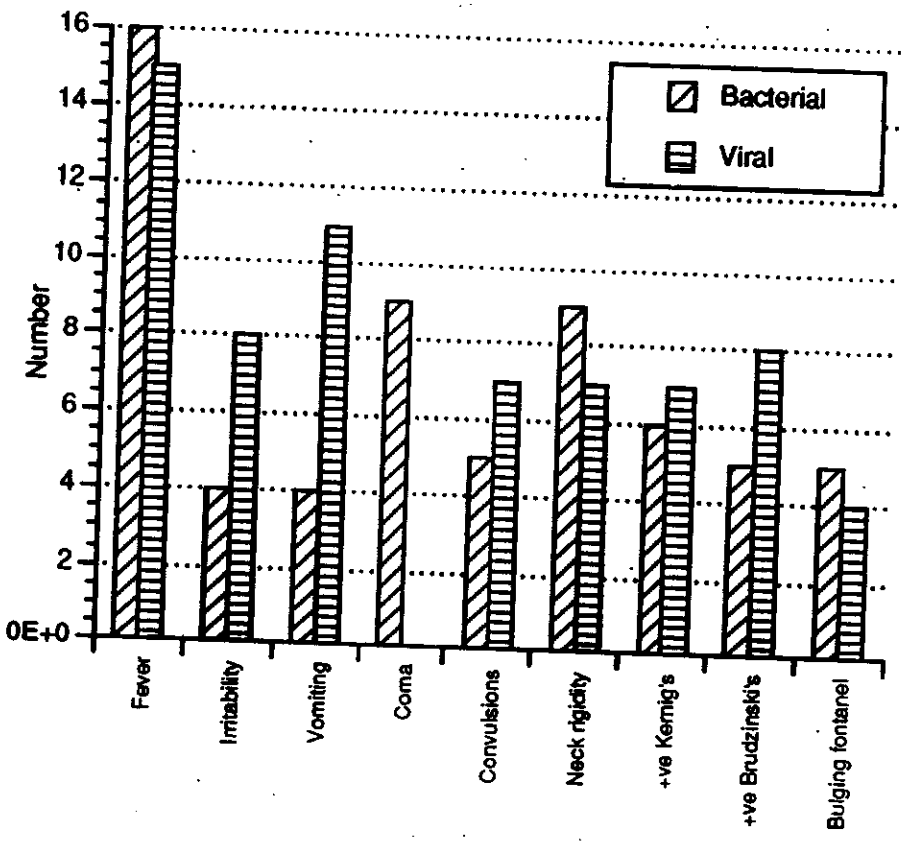

Figure (6): Distribution of bacterial and viral groups of meningitis regarding symptoms and signs.

Table (4): Comparison between bacterial and viral groups of meningitis versus control groups regarding blood and CSF parameters.

Parameters	Control (10)	Bacterial Group (16)			Viral Group (15)		
	$\bar{X} \pm SD$	$\bar{X} \pm SD$	t	P	$\bar{X} \pm SD$	t	P
T.L.C.	8400±1837	17875±2276	9.9	<0.001	993 ±1032	1.6	>0.05
Differential:							
Neutrophils	46.5% 8.1	77.8% 2.8	11.7	<0.05	22.7% 2.4	9.3	<0.05
Lymphocytes	53.5%	22.2%			77.3%		
C.S.F. exam.:							
Cells (/mm³)	0 0	1225 738	6.2	<0.001	273 143	5.9	<0.05
Protein (mg/dl)	30 6.6	137.8 24.6	13.4	<0.001	62 6.7	9.3	<0.05
Glucose (mg/dl)	60 6.6	10.3 5.3	24	<0.0001	58.8 5.2	1.5	>0.05

In bacterial group the total leukocytic count (TLC) was significantly higher than in control group. The differential count showed significant increase in neutrophils compared to control group. CSF parameter showed highly significant increase in leukocytes mainly PMNL, highly significant increase in protein concentration and highly significant decrease in glucose concentration compared to control group. Detais are described in table (4).

In viral group, TLC was mildly increased compared to control group but the difference was not statistically significant. The differential count showed significant increase in lymphocytes compared to control group, ($P<0.05$). CSF parameters showed significant increase in cells mainly lymphocytes, moderate increase in protein concentration which was significantly higher compared to control group and normal glucose concentration as shown in table (4).

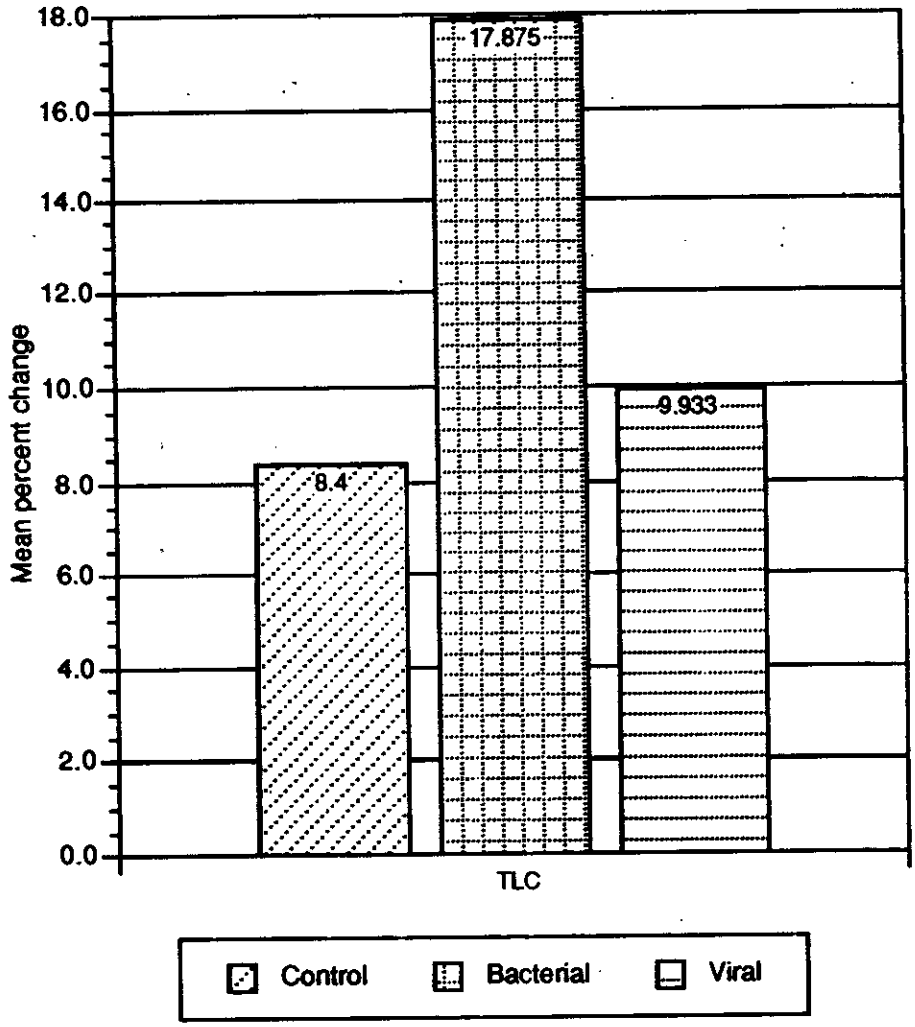

Figure (7): Comparison of total leucocytic count in control, bacterial and viral groups

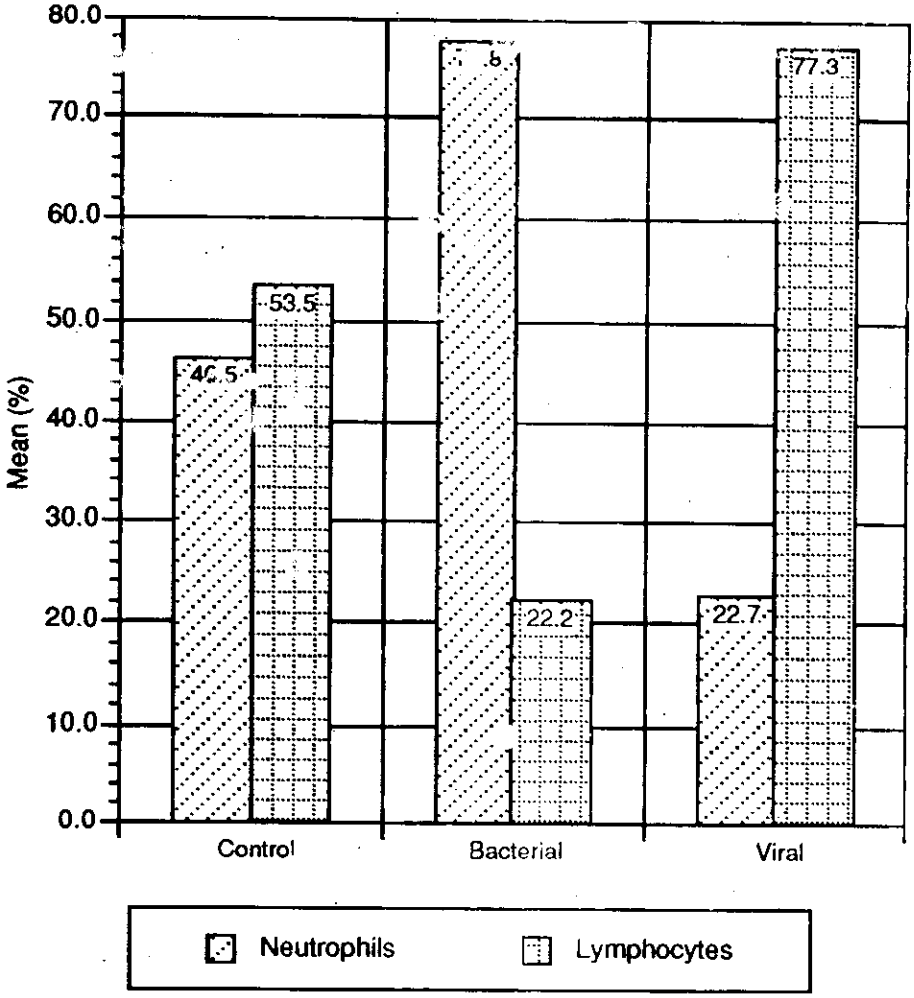

Figure (8): Comparison of differential leucocytic count in control, bacterial and viral groups

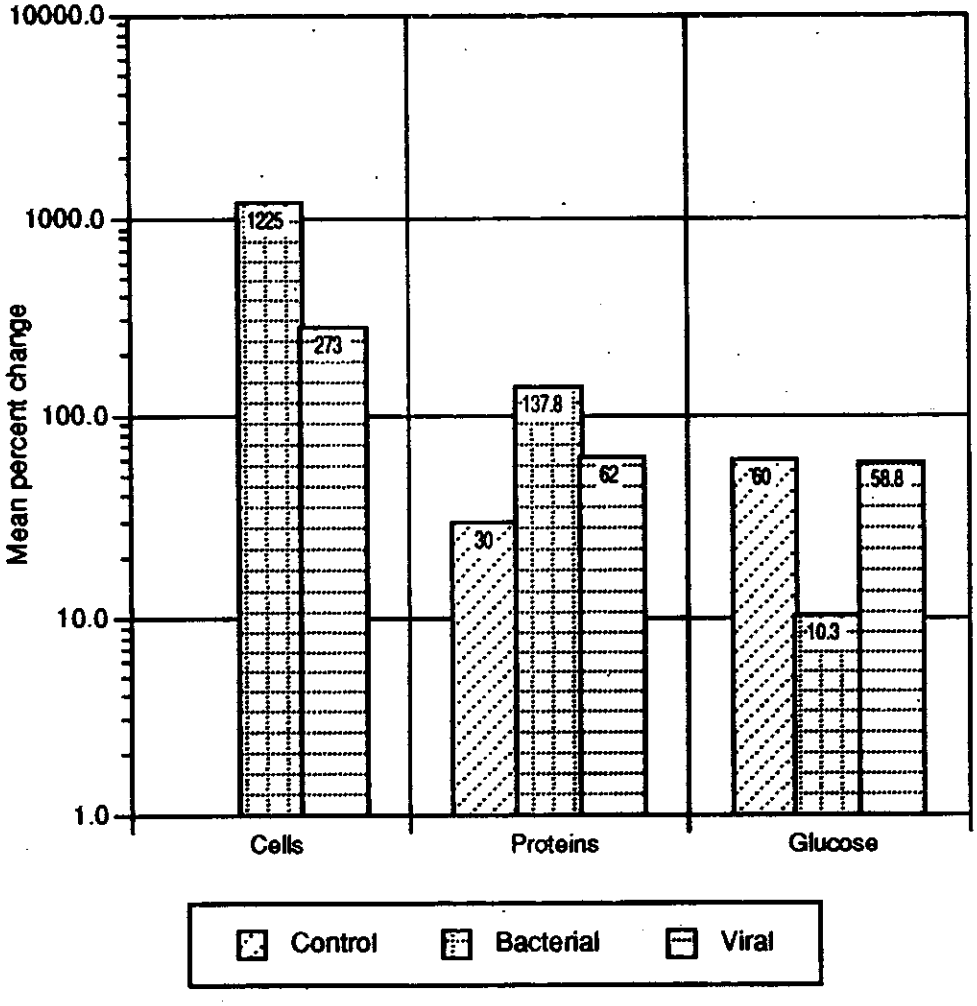

Figure (9): CSF parameters in control, bacterial and viral groups

Table (5): Comparison between bacterial group of meningitis versus viral group regarding blood and CSF parameters.

Symptoms and Signs	Bacterial Group (16) $\bar{X} \pm SD$		Viral Group (15) $\bar{X} \pm SD$		t	P
T.L.C.	17875	2276	9933	1032	10.8	<0.001
Differential:						
Neutrophils	77.8%	2.8	22.7%	2.4	3438	<0.0001
Lymphocytes	22.2%		77.3%			
C.S.F. Exam.:						
Cells	1225	738	273	143	4.8	<0.001
Protein	137.8	24.6	62	6.7	11.4	<0.001
Glucose	10.3	5.3	58.8	5.2	3467	<0.0001

The total leukocytic count (TLC) showed highly significant increase in bacterial group compared to viral group. The differential count showed increase in neutrophil count in bacterial group and increase in lymphocytic count in viral group, the difference was highly significant

CSF parameters showed highly significant increase in cells, highly significant increase in protein concentration and highly significant decrease in glucose concentration in bacterial group compared to viral group as shown in table (5).

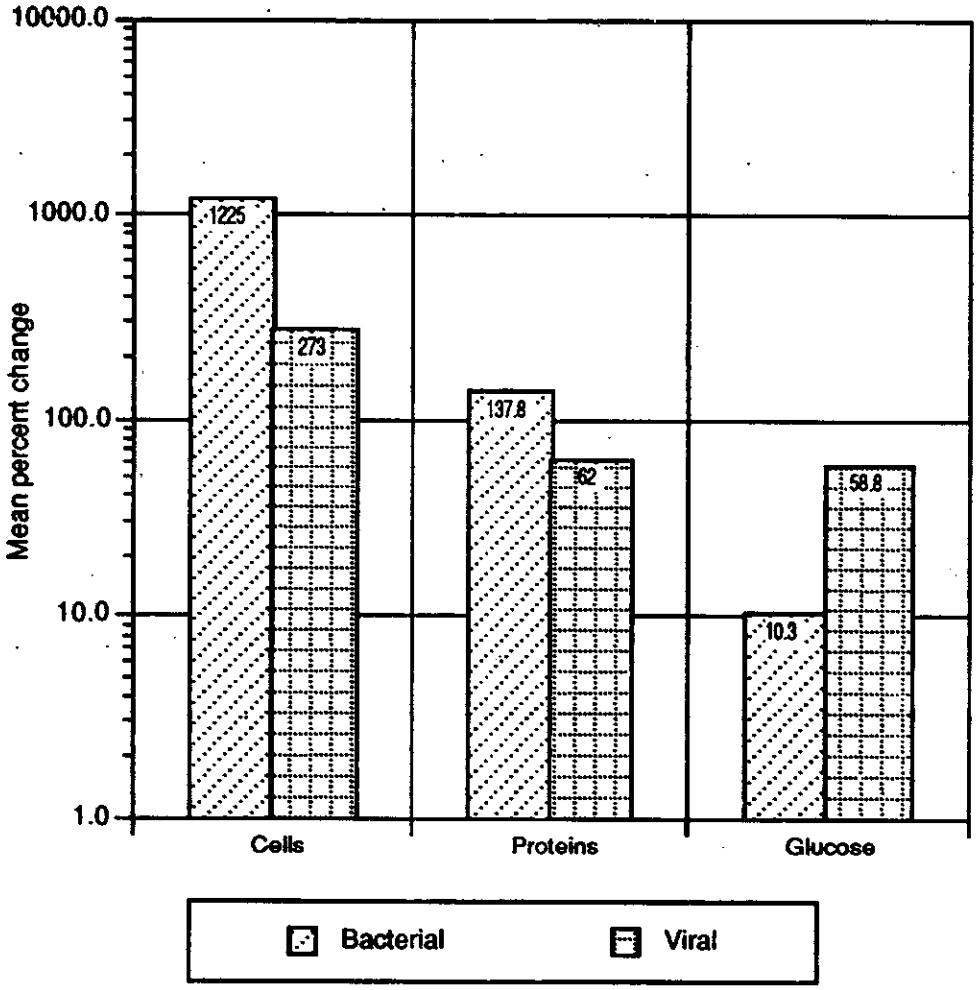

Figure (10): CSF parameters in bacterial and viral groups

Table (6): Distribution of positively detected CSF, serum IL-10 and CSF, serum TNFα among bacterial and viral cases of meningitis.

	Bacterial Group (16)	Viral Group (15)	X^2	P
+ve detected CSF IL-10	16	8	7.1	<0.01
+ve detected serum IL-10	14	5	7.4	<0.01
+ve detected CSF TNFα	16	4	15.1	<0.0001
+ve detected serum TNFα	16	2	20.4	<0.00001

X^2 = Chi-square test

In bacterial cases IL-10 was detected in all CSF samples (16) compared to (8) out of (15) (53.3%) CSF sample in viral cases. Regarding the serum, IL-10 was detected in (14) out of (16) samples in bacterial cases (87.5%) compared to (5) out of (15) (33.3%) in viral cases, so the distribution is highly significant in bacterial cases compared to viral cases. TNFα was detected in all CSF samples (16) of bacterial cases compared to 4 out of (15) (26.6%) in viral cases. Regarding serum samples TNFα was detected in all bacterial cases (16) compared to (2) out of (15) (13.3%) in viral cases. The difference was highly significant as shown in table (6).

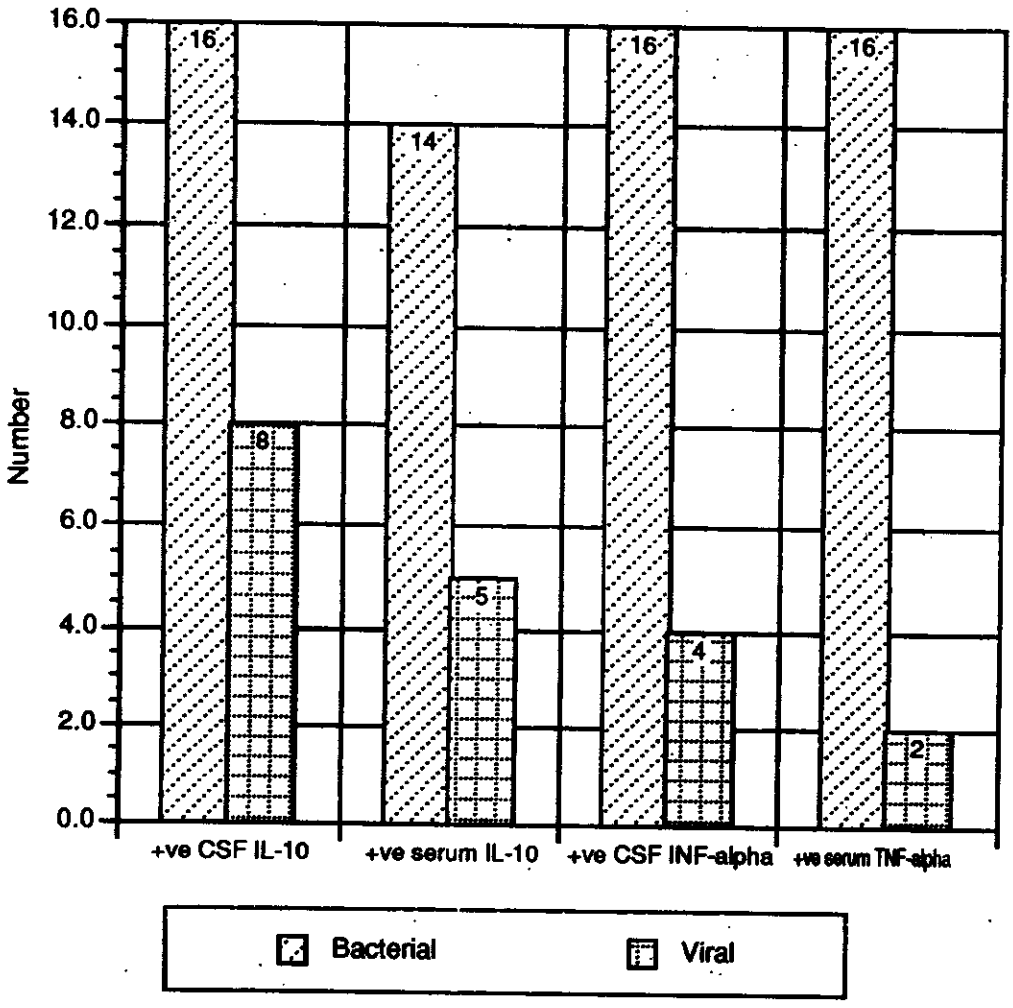

Figure (11) Distribution of positively detected CSF & serum IL-10 and CSF & serum TNF-alpha among bacterial and viral cases of meningitis

Table (7): Comparison between bacterial meningitis group versus control group regarding IL-10 in CSF and serum, and viral meningitis group versus control group regarding IL-10 in CSF.

Parameters	Control (10)	Bacterial Group (16)			Viral Group (8)		
			test	P		test	P
C.S.F. IL-10: pg/ml							
Median	4.2	275.2	17.7	<0.0001	18.8	12.6	<0.01
Range	1.1 – 7.3	12.9 – 899.1			11.6 – 45.1		
Serum IL-10: pg/ml	No. (10)	No. (14)	test	P			
Median	3.1	26.4	16.8	<0.001			
Range	0 – 7.2	14.9 – 118.5					

test : Kruskal Wallis nonparametric test.

In bacterial group, CSF IL-10 showed a highly significant increase compared to control group. Serum IL-10 in bacterial group showed a highly significant increase compared to control group. In viral group CSF IL-10 showed a highly significant elevation compared to control group. Details are described in table (7).

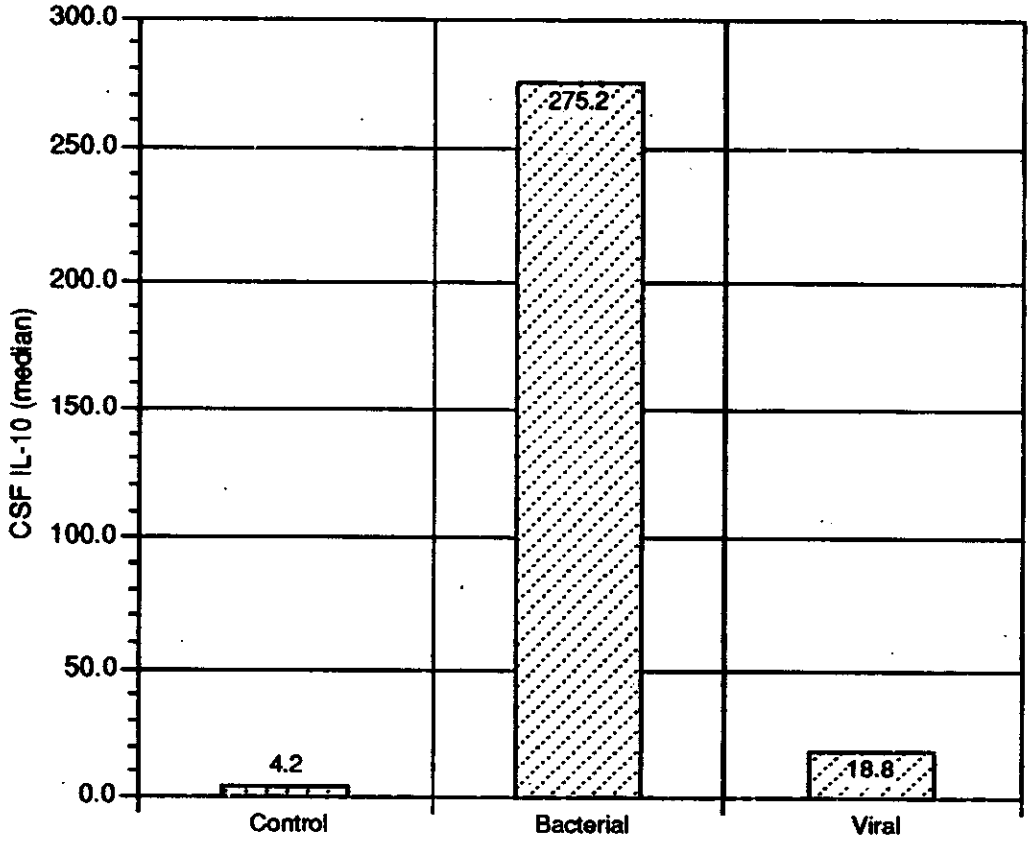

Figure (12): CSF IL-10 in control, bacterial and viral groups

Table (8): Comparison between bacterial meningitis group versus viral meningitis group regarding CSF IL-10.

Variables	Bacterial Group (16)	Viral Group (8)	Non-barometric test	P
CSF IL-10 : pg/ml				
Median	275.2	18.8	16.6	<0.001
Range	12.9 – 899.1	11.6 – 45.1		

In bacterial group CSF IL-10 showed a highly significant increase compared to CSF IL-10 in viral group as shown in table (8). The comparison between serum IL-10 in bacterial and viral groups was not statistically significant as serum IL-10 detected only in 5 cases in viral group.

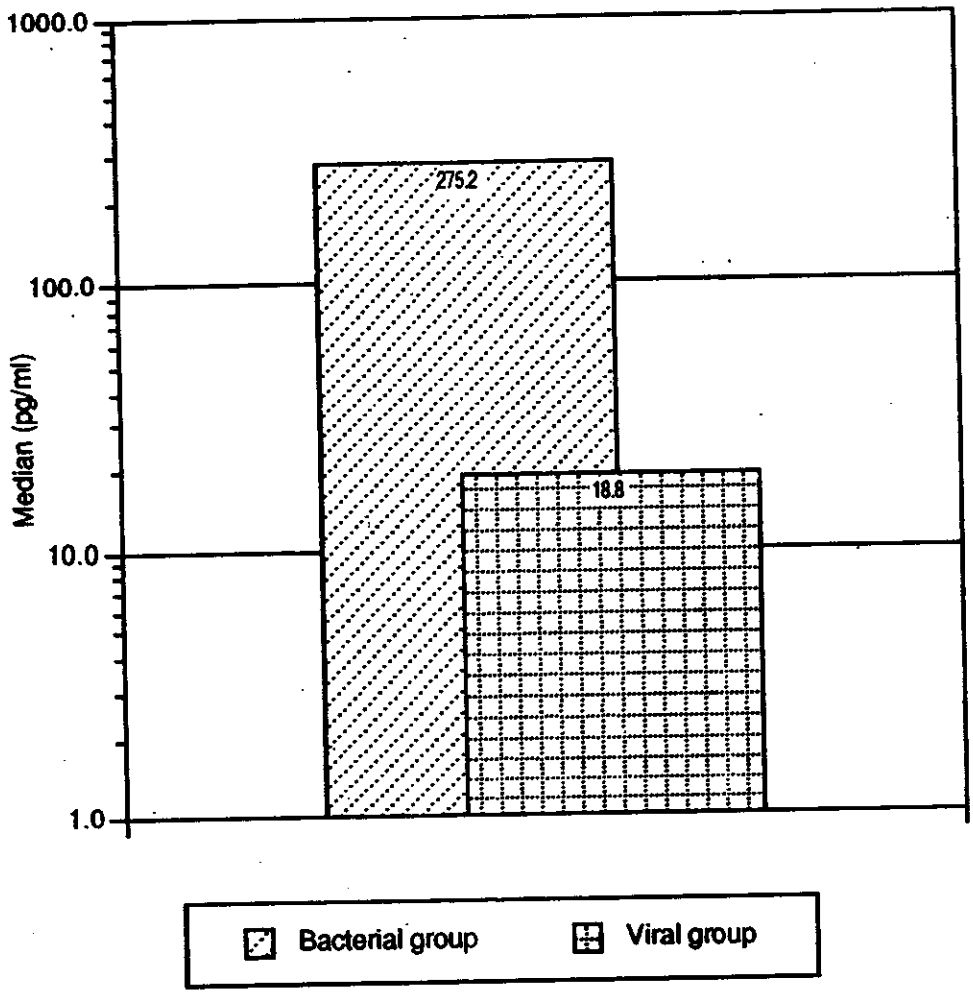

Figure (13): median value of CSF IL-10 in bacterial meningitis group versus viral meningitis group

Table (9): Comparison between bacterial meningitis group versus control group regarding CSF and serum TNFα.

	Controls (10)	Bacterial Group (16)	Non-barometric test	P
CSF TNFα: pg/ml				
Median	1.8	148.1	17.7	<0.0001
Range	0 – 3.7	23 – 1832		
Serum TNFα: pg/ml	10	16	test	P
Median	3.2	37	16.8	<0.001
Range	1.9 – 4.2	11.6 – 789		

CSF TNFα showed a highly significant increase in bacterial group compared to control group. Serum TNFα was significantly elevated in bacterial group compared to control group details are described in table (9).

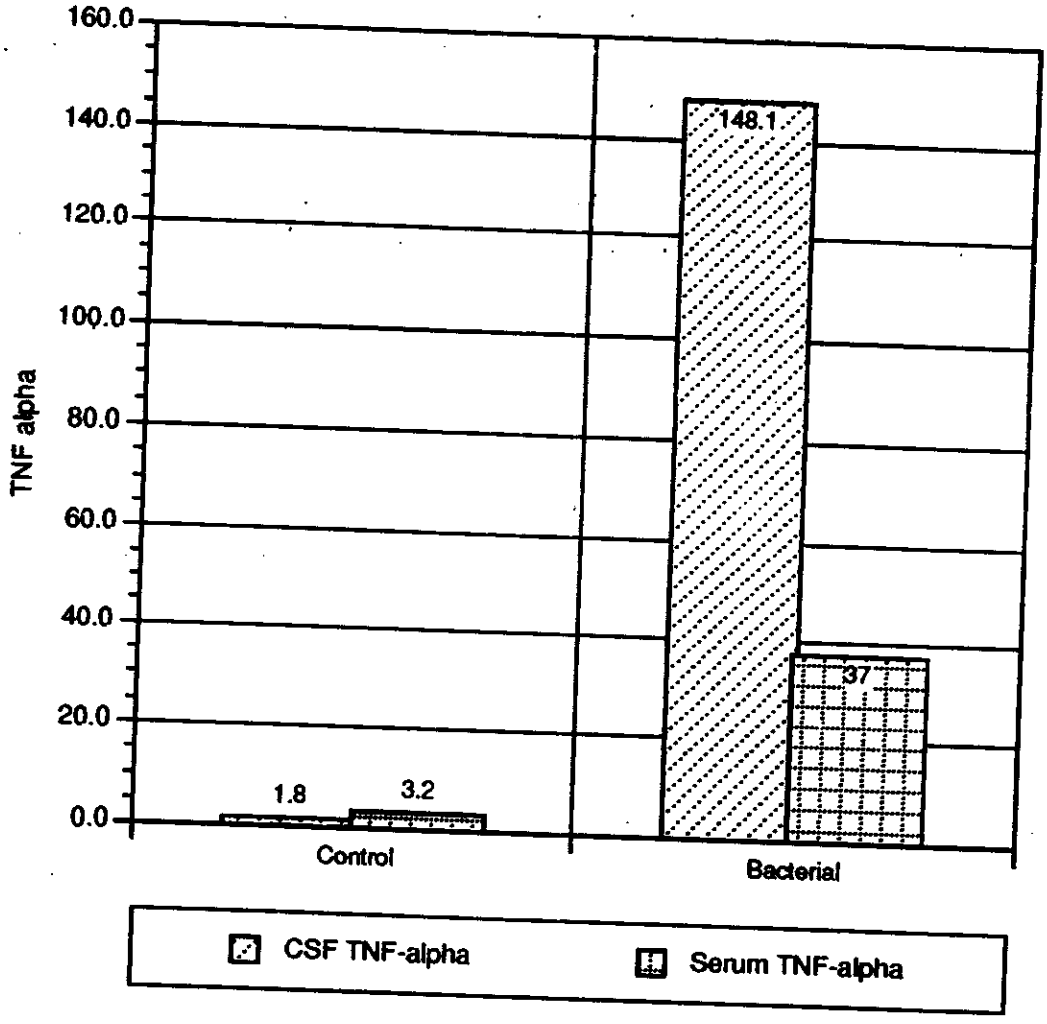

Figure (14): CSF and serum TNF alpha in control and bacterial groups

Table (10): Comparison between IL-10 level in CSF and serum among bacterial and viral cases of meningitis.

Variables	$\bar{X}$ d (CSF and serum IL-10) (pg/ml)	SD	Paired t test	P
Bacterial meningitis	312.2	310.7	3.8	<0.0001
Viral meningitis	16.1	8.8	1.6	<0.01

In bacterial group there was a highly significant increase in CSF IL-10 level compared to serum IL-10 level. In viral group CSF IL-10 was significantly increased compared to serum IL-10 as shown in table (10).

Table (11): Comparison between TNFα level in CSF and serum among bacterial group of meningitis.

Variables	$\bar{X}$ d (CSF and serum TNFα) (pg/ml)	SD	Paired t test	P
Bacterial Meningitis	654	764.7	3.9	<0.0001

There was a highly significant increase in CSF, TNFα compared to serum TNFα level as shown in table (11).

Table (12): Correlation coefficient between CSF IL-10 level with CSF glucose concentration, protein concentration and white blood cells count in bacterial and viral cases of meningitis.

Variables	Bacterial meningitis (IL-10 level)		Viral meningitis (IL-10 level)	
	r	P	r	P
CSF glucose concentration	– 0.55	< 0.05	– 0.004	> 0.05
CSF cells	+ 0.56	< 0.05	+ 0.51	< 0.05
CSF protein concentration	+ 0.49	< 0.05	+ 0.45	> 0.05
	Critical value at two tails = +/- 0.49		Critical value at two tails = +/- 0.51	

In bacterial group there was a significant negative correlation between CSF IL-10 and glucose concentration. CSF IL-10 was significantly correlated positively with CSF protein concentration and CSF WBCs count. In viral group there was only a significant positive correlation between CSF IL-10 and CSF WBCs as shown in table (12).

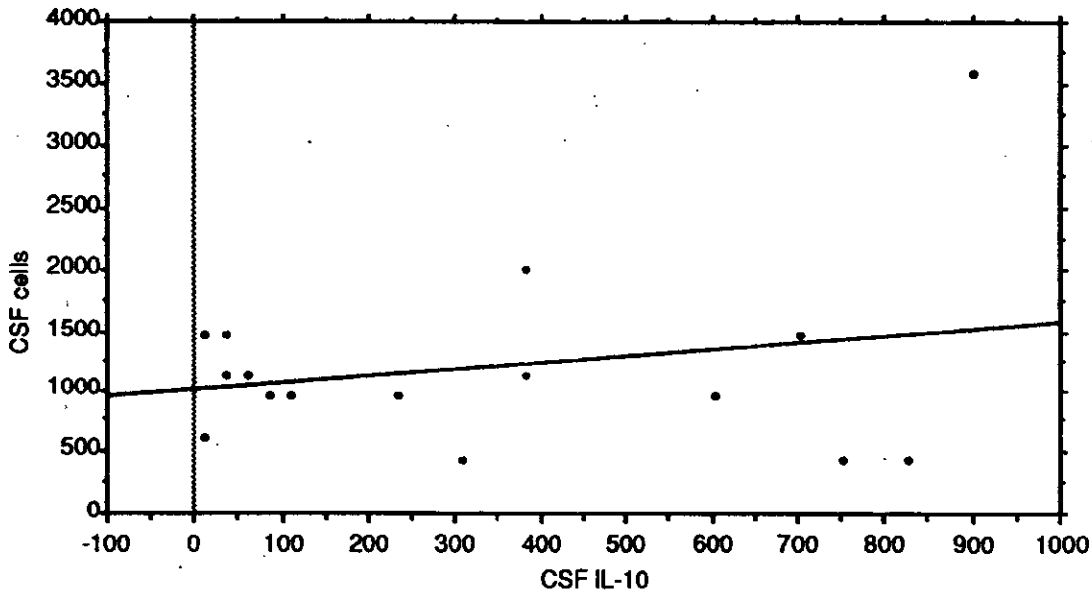

Figure (15): Correlation between number of cells and IL-10 level in CSF of bacterial meningitis group

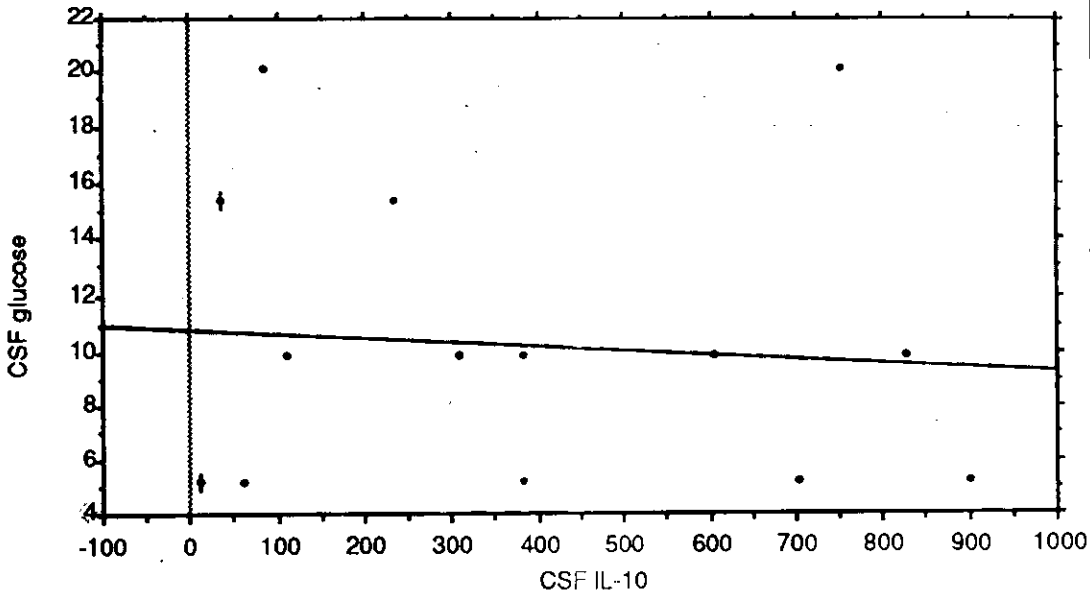

Figure (16): Correlation between glucose and IL-10 levels in CSF of bacterial meningitis group

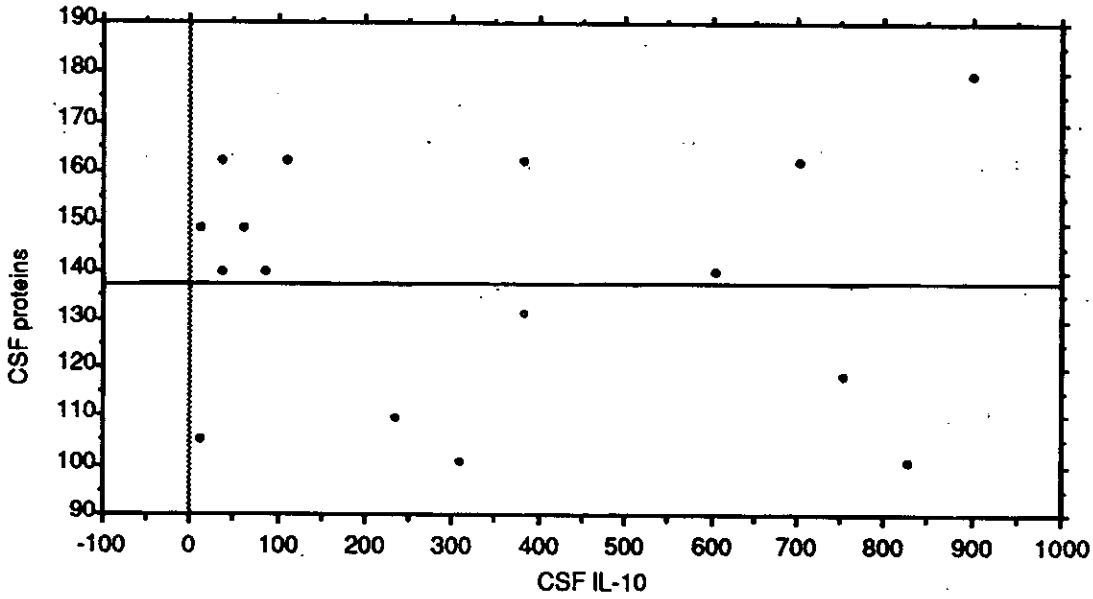

Figure (17): Correlation between proteins and IL-10 levels in CSF of bacterial meningitis group

Table (13): Correlation coefficient between CSF TNFα level and CSF glucose concentration, protein concentration and WBCs count in bacterial group of meningitis.

Variables	Bacterial meningitis (TNFα level)	
	r	P
CSF glucose concentration	– 0.54	< 0.05
CSF cells (WBCs)	+ 0.56	< 0.05
CSF protein concentration	+ 0.50	< 0.05

Critical value at two tails = +/- 0.49

There was a significant negative correlation between CSF, TNFα and glucose concentration. CSF, TNFα was significantly correlated positively with CSF protein concentration and WBCs count as shown in table (13).

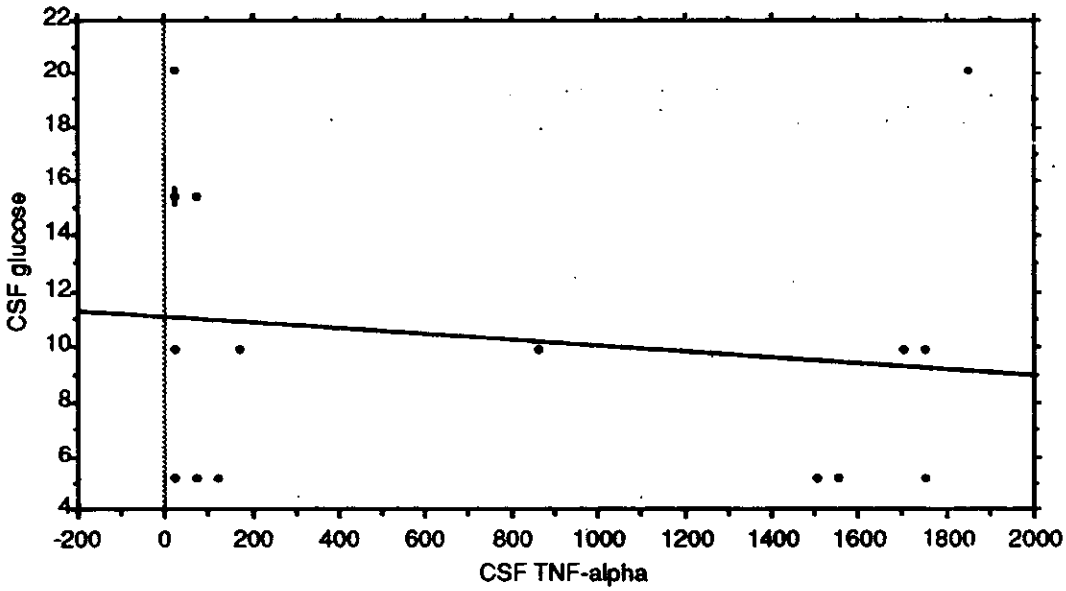

Figure (18): Correlation between glucose and TNF-alpha levels in CSF of bacterial meningitis group

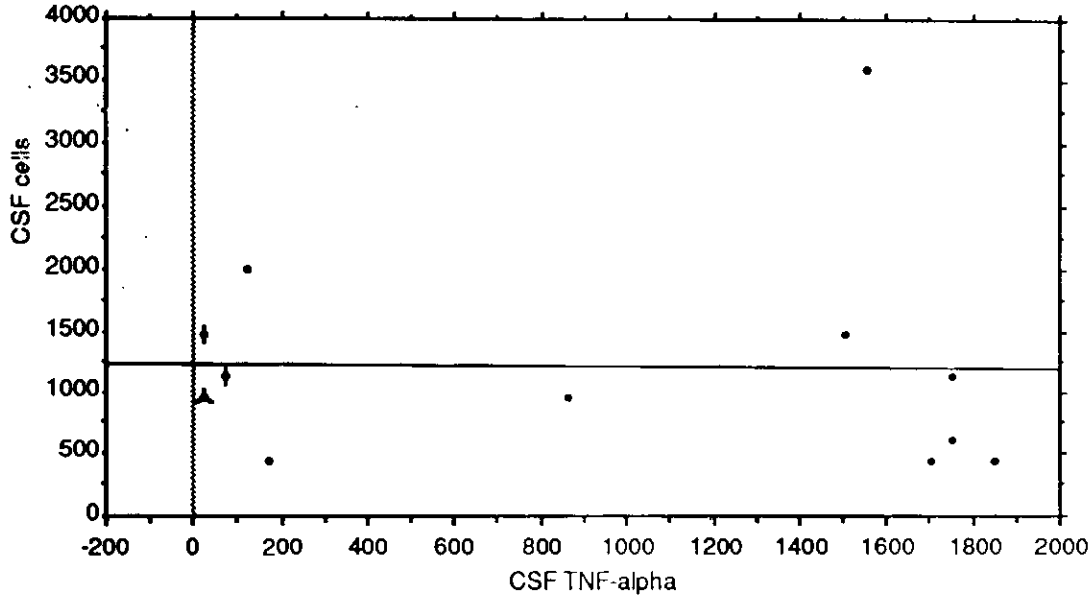

Figure (19): Correlation between number of cells and TNF-alpha level in CSF of bacterial meningitis group

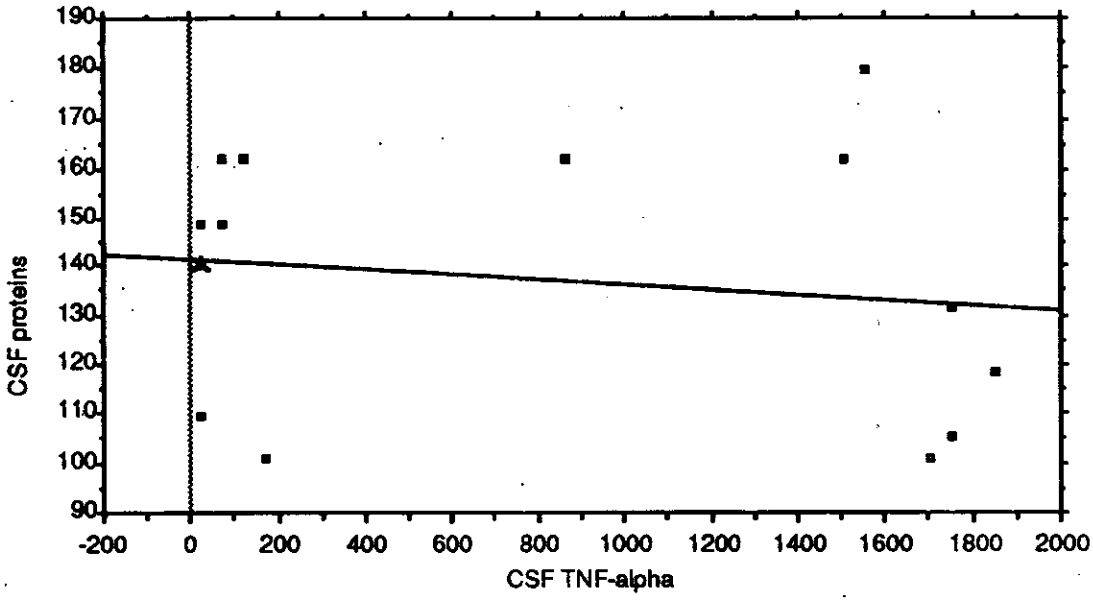

Figure (20): Correlation between protein and TNF-alpha levels in CSF of bacterial meningitis group

Table (14): Correlation coefficient between CSF IL-10 and TNFα in bacterial meningitis group.

Variables	Bacterial meningitis group (CSF, TNFα level)	
	r	P
CSF, IL-10	+ 0.58	< 0.05

In tis table there was a significant positive correlation between CSF IL-10 and TNF-alpha.

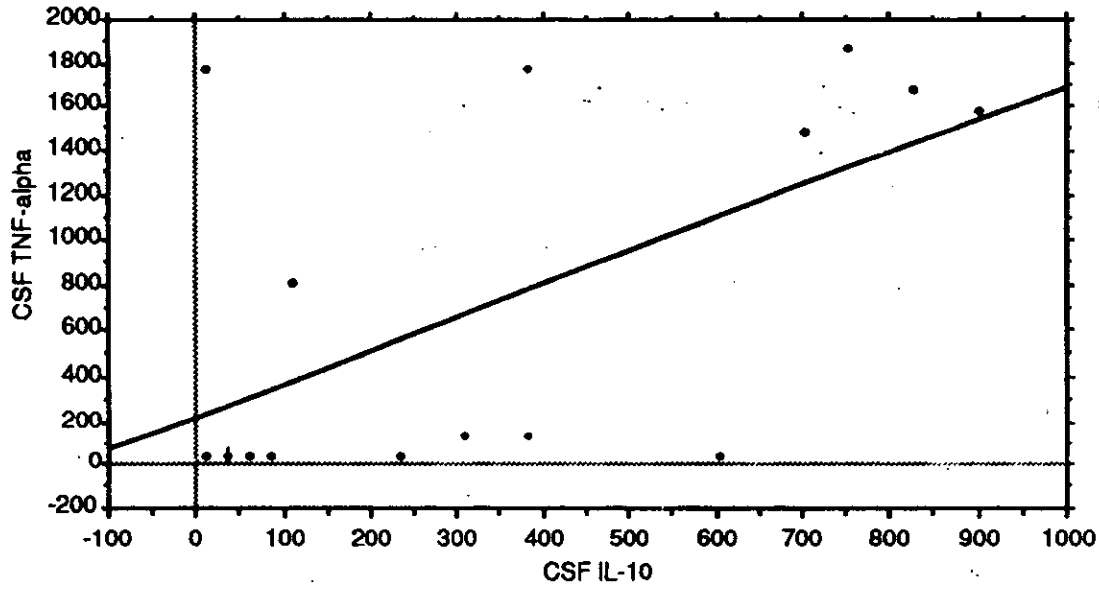

Figure (21): Correlation between IL-10 and TNF-alpha levels in CSF of bacterial meningitis group

Table (15): Correlation coefficient between serum IL-10 and TNFα in bacterial meningitis group.

Variables	Bacterial meningitis group (Serum TNFα level)	
	r	P
Serum IL-10	+ 0.53	< 0.05

In tis table there was a significant positive correlation between serum IL-10 and TNF-alpha.

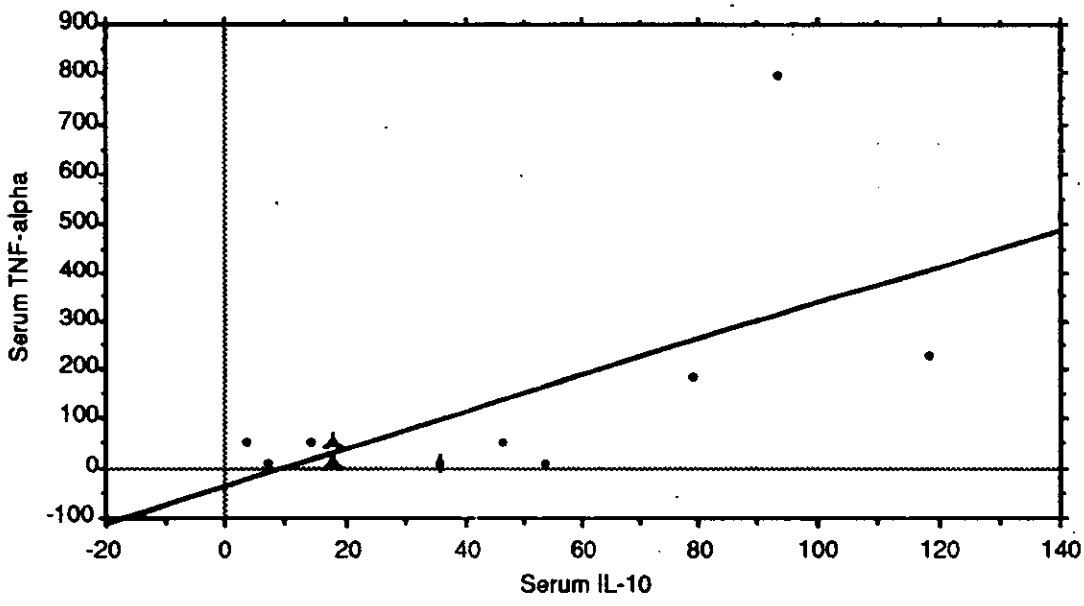

Figure (22): Correlation between serum IL-10 and TNF-alpha levels in bacterial meningitis group