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Filariasis in its Relation to A_1A_2BO, MN, Kell, Duffy and Rhesus Blood Groups and Secretor Factor

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Recently, there has been much emphasis on the study of the relationship between blood groups and various diseases (Roberts, 1956/57). It has been shown that group A is quite frequent in patients with the cancer of stomach, pancreas or oesophagus (Aird et al., 1953) while blood group O is common in the patients suffering from peptic ulcer (Aird et al., 1954); whereas the associations of duodenal ulcer with blood group O (Aird et al., 1954; Clarke et al., 1955) and with salivary ABH non-secretion (Clarke et al., 1956) are firmly established. There is no association between pulmonary tuberculosis and blood groups (Navani et al., 1962; Shenoy et al., 1962) whereas there is a significant difference between the frequency of blood groups O and A in the patients suffering from sarcoidosis and tuberculosis (Lewis et al., 1961). In earlier studies, it has been shown that A and B blood group people are susceptible to eosinophilia (Anand, 1961); O blood group to renal lithiasis (Anand, 1964); O blood group to rheumatic fever (Buckwalter et al., 1962), and B and R_1R_1 blood groups to asthma (Anand, 1964). It is, however, distressing to note that filariasis, which is prevalent in India from the ancient times, has not been studied for its susceptibility to the various blood groups. Filariasis, commonly known as elephantiasis, leads to the permanent swelling of the legs and of certain other parts of the body, besides causing recurring attacks of fever and inflammation of the lymphatic system. Though the disease is not fatal, it is responsible for a considerable amount of preventable sufferings and disabilities. In India *Wuchereria bancrofti* and *Wuchereria malayi* are responsible for the filarial infections, both being transmitted by mosquitoes. Thus, in this study, an attempt has been made to find out the association, if any, between filariasis and blood groups.

Material and methods

From the 603 patients suffering from filariasis, examined for A_1A_2BO blood groups, 281 were examined for Duffy, Kell and Rhesus blood groups, 178 for secretor factor and 503 for MN blood groups. These patients were drawn from the Ispat General Hospital at Rourkela during the months of February and March 1963.

There was no selection of patients except by the diagnostic criteria. A diagnosis

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of filariasis was made clinically by *swelling*, pain, fever and was later pathologically confirmed for the presence of microfilarae in the ' blood sheet '. The appearance of microfilarae during nights and their disappearance during daytime necessitated the obtaining of blood samples for detecting filarial infection only at night. The blood smears were air dried, stained with J.S.B. stain and examined for microfilaria by the pathologists of the said hospital. Site of the disease-accumulation of the filaria was also taken into account.

The antisera used were anti-C, anti-c, anti-D, anti-E and anti-e for Rhesus blood groups; anti-M and anti-N for MN blood groups; anti-Fya for Duffy; anti-K for Kell; anti-A, anti-B, Anti-A_1, Anti-H and seed extract of *dolichos biflorus* for A_1A_2BO blood groups and secretion of ABO(H) group specific substances in the saliva. The techniques recommended by the anti-sera suppliers and Dunsford and Bowley (1956) were employed for testing the blood samples. The tests for the analysis of the blood groups A_1A_2BO, MN and secretor factor were done on the ' tiles ' whereas those for Kell, Duffy and Rhesus blood group in the microtubes. These tubes were incubated at 37°C for one hour and results were read macroscopically; the negative tests being checked microscopically as well.

The different statistical methods have been selected for the present study in order to:

I) find out whether there is any association between the blood groups and the disease;
II) find out the nature of such an association;
III) show the variability of the genes in the patients from those in the control groups.

The possibility of an association of filariasis with the above mentioned blood groups was done by comparing the blood group frequencies observed in these patients with those observed in the control. The conventional χ^2 method has also been used to examine the differences which occur in the blood group frequencies of the patients and those of the control. The results of these analyses are given in the first parts of Tables 1, 3, 5 and 7. The data have also been examined by Woolf's modified method (1955) in which the incidence of the disease in persons of one blood group is compared with the incidence of the disease in the other blood groups, taken one at a time; the incidence being derived from the blood group frequencies of the patients and the control. In Tables 2, 4, 6 and 8, permutation tests (Penrose, 1961) have also been applied to find out whether the presence or absence of a given gene (blood group) has any influence on susceptibility to the disease under study, and also to test the hypothesis that the blood groups and the diseases are independent of each other.

Results and discussion

In Tab. 1, A_1A_2BO blood group distribution in the patients and the control is shown. The figures include both sexes as there was no demonstrable differences in blood group distributions between them. The observed percentages of patients and

control series in A_1A_2BO blood groups separately show no significant differences and these findings are further supported by their conventional χ^2 tests (in the 1st part). The total χ^2 for observed and expected values in the patients and control is 0.6915, for which the probability for five degrees of freedom is too high, i.e., 0.98. In the second part of the table, relative incidence (X) of filariasis in blood group A_1 with other blood groups is recorded. But none of them gave any significant results. Furthermore, the different values of χ^2 for the various blood groups in relation to blood group A_1 confirms the results obtained from the relative incidences and also the χ^2 values (as shown in part one of Tab. 1).

Tab. 1. A_1A_2BO: Percentage distribution of the phenotypes in the patients and control, their conventional χ^2 and the relative incidence

Phenotypes	Part I						Part II			
	Controls		Patients		χ^2		Relative incidence (X)	(Y)	χ^2	Probability**
	no.	%	no.	%						
A_1	107	21.97	130	21.56	0.0210					
A_2	17	3.49	17	2.82	0.3858	A_2: A_1	0.8233	—0.1952	0.2814	<.70->.50
B	161	33.06	206	34.16	0.0979	B: A_1	1.0529	+0.0516	0.0954	<.80->.90
O	164	33.67	206	34.16	0.0190	O: A_1	1.0335	+0.0329	0.2598	<.70->.50
A_1B	32	6.57	38	6.32	0.0297	A_1B: A_1	0.9787	—0.0229	0.0070	<.95->.90
A_2B	6	1.23	6	0.99	0.1381	A_2B: A_1	0.9961	—0.0041	0.1070	<.80->.70
Total	487		603		0.6915*					

* The probability is 0.98 for five degrees of freedom.
** The degree of freedom is one.

In Tab. 2, the difference of observed and expected values, separately for each blood group, has been divided by the square root of the variance, i.e. σ, to find out the standardized normal deviation (D/σ). These deviations are nonsignificant, for their probabilities range between 0.52 and 0.87, the level of significance being re-

Tab. 2. The observed and expected numbers, variance and D/σ for the A_1A_2BO phenotypes of the patients

Phenotypes	Obs. no. T(O)	Exp. no. T(E)	Variance $\pm \sigma$	D/σ	Probability
A_1	130.00	131.11	45.80 ± 6.7675	—0.1641	<.87->.86
A_2	17.00	18.81	8.10 ± 2.8460	—0.6356	<.53->.52
B	206.00	203.03	60.20 ± 7.7589	+0.3829	<.71->.70
O	206.00	204.69	60.40 ± 7.7717	+0.1689	<.87->.86
A_1B	38.00	38.72	16.20 ± 4.0249	—0.1801	<.86->.85
A_2B	6.00	6.64	2.93 ± 1.7117	—0.3731	<.70->.71

garded as 0.05. These different probabilities have been plotted against their respective blood groups in Fig. 1.

The frequency of MN blood groups in the patients and the controls shows slight variations. The relative incidence (1.2986) in NN : MM is comparatively high,

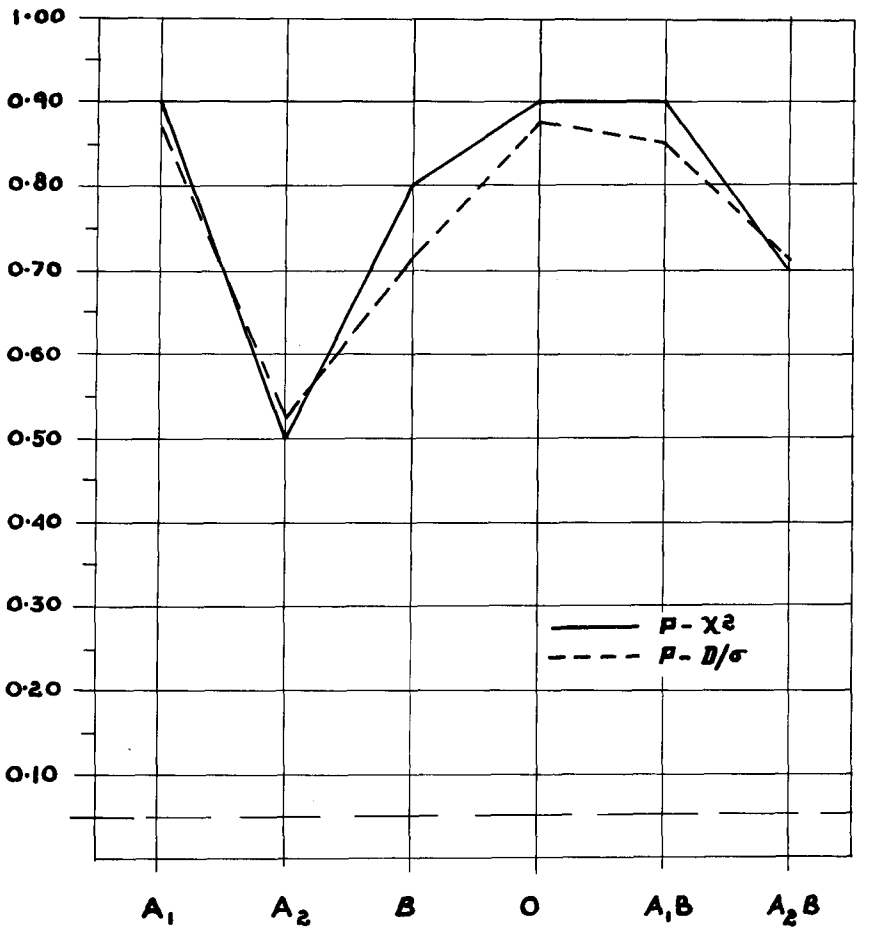

Fig. 1. Probability polygons of the χ^2 and the D/σ for the A_1A_2BO blood groups

and similarly its χ^2 (2.0485) is also high for one degree of freedom. Though the value of D/σ is quite high (1.5786), it does not cross the level of significance, for its probability lies between 0.11-0.12, and it confirms the results obtained by Woolf's (1955) modified method (Tab. 3). The mere increase of frequency of N blood group in the patients does not indicate its susceptibility to filariasis.

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Tab. 3. MN: Percentage distribution of the phenotypes in the patients and controls, their conventional χ^2 and the relative incidence

Phenotypes	Part I						Part II			
	Controls		Patients				Relative incidence (X)	(Y)	χ^2	Probability
	no.	%	no.	%	χ^2					
MM	219	44.97	262	43.45	0.1406					
MN	203	41.68	240	39.80	0.2346	MN:MM	0.9884	—0.0124	1.0080	<.50->.30
NN	65	13.35	101	16.75	2.0494	NN:MM	1.2989	+0.2617	2.0485	<.20->.10
Total	487		603		2.4246*					

* The probability for two degrees of freedom is 0.30.

Tab. 4. The observed and expected numbers, variance and D/σ for the MN phenotypes of the patients

Phenotypes	Obs. no. T(O)	Exp. no. T(E)	Variance $\pm$ σ	D/σ	Probability
MM	262.00	266.09	66.40 $\pm$ 8.1486	—0.5025	<.62->.61
MN	240.00	245.07	65.00 $\pm$ 8.0622	—0.6292	<.53->.52
NN	101.00	91.84	34.89 $\pm$ 5.8068	+1.5786	<.12->.11

The variation between the observed and expected values for the secretion of ABO(H) group specific substances in saliva, and for Kell and Duffy blood groups in the patients and the controls is negligible (Tables 5 and 6).

Furthermore, their high probabilities (0.92-0.98) and low χ^2 values (0.0010-0.0316) support these findings. The relative incidence for se: Se, K— : K+, and Fy^{a-} : Fy^{a+} also shows the absence of any association of these particular characters with filariasis, their values being 0.9909, 1.1916 and 1.0818 respectively.

As is seen from Tables 7 and 8 there is no significant difference in the incidence of filariasis in persons with any of the genotype of rhesus factor. The total χ^2 (0.5784) for eight degrees of freedom does not show any significant difference between the observed frequencies in the patients and control. The relative incidence of filariasis in each genotype has been found out by comparing it with the genotype Rh_1Rh_1 because the frequencies of this homozygous genotype in the patient and the control series was quite similar. In Rh_2Rh_2 genotype the value of relative incidence (1.5530) is slightly high, but further statistical methods of χ^2 and standardized normal deviation (D/σ) do not confirm any association, because the probability for its χ^2 (0.3720) ranges from 0.50 to 0.70.

With permutation tests, the differences obtained between the observed and the expected frequencies of the various Rh-genotypes in the patients is negligible. The

Tab. 5. Secretor factor, Kell, Duffy: Percentage distribution of the phenotypes in the patients and controls, their conventional χ^2 and the relative incidence

Phenotypes	Part I						Part II			
	Controls		Patients				Relative incidence (X)	(Y)	χ^2	Probability
	no.	%	no.	%	χ^2					
Secretor	173	86.07	153	85.96	0.0001					
Nonsecretor	28	14.04	25	13.93	0.0009	se: Se	0.9909	—0.0109	0.0011	<.95->.90
Total	201		178		0.0010*					
K+	59	12.71	37	13.17	0.0276					
K—	405	87.29	244	86.83	0.0040	K—: K+	1.1916	+0.1752	0.0316	<.90->.80
Total	464		281		0.0316*					
Fy^{a+}	314	66.10	185	65.84	0.0020					
Fy^{a-}	161	33.90	96	34.16	0.0038	Fy^{a-}: Fy^{a+}	1.0818	+0.0879	0.0058	<.95->.90
Total	475		281		0.0058*					

* For one degree of freedom the probability is 0.95, 0.90 and 0.98, respectively.

Tab. 6. The observed and expected numbers, variance and D/σ for the secretor factor, Kell and Duffy phenotypes of the patients

Phenotypes	Obs. no. T(O)	Exp. no. T(OE)	Variance $\pm \sigma$	D/σ	Probability
Secretor	153.00	153.11	11.03 ± 3.3616	—0.0321	<.98->.97
Nonsecretor	25.00	24.89	11.03 ± 3.3616	+0.0321	<.98->.97
K+	37.00	36.21	19.67 ± 4.4351	+0.1783	<.86->.85
K—	244.00	244.79	19.67 ± 4.4351	—0.1783	<.86->.85
Fy^{a+}	185.00	185.47	39.42 ± 6.2785	+0.0756	<.94->.93
Fy^{a-}	96.00	95.53	39.42 ± 6.2785	—0.0756	<.94->.93

Tab. 7. Rh-factor: Percentage distribution of the phenotypes in the patients and controls, their conventional χ^2 and the relative incidence

Phenotypes	Part I						Part II			
	Controls		Patients				Relative incidence (X)	(Y)	χ^2	Probability
	no.	%	no.	%	χ^2					
Rh_1Rh_1	146	34.03	94	33.45	0.0167					
Rh_1Rh_2	75	17.48	49	17.44	0.0074	Rh_1Rh_2: Rh_1Rh_1	1.0150	+0.0148	0.0041	<.95->.90
Rh_1rh	131	30.54	84	29.89	0.0230	Rh_1rh: Rh_1Rh_1	0.9957	—0.0057	0.0004	<.99->.98
rh′rh	9	2.09	7	2.49	0.1173	rh′rh: Rh_1Rh_1	1.2120	+0.1923	0.1304	<.80->.70
Rh_2Rh_2	4	0.93	4	1.42	0.2882	Rh_2Rh_2: Rh_1Rh_1	1.5530	+0.4401	0.3720	<.70->.50
Rh_2rh	11	2.56	8	2.85	0.0507	Rh_2rh: Rh_1Rh_1	1.1326	+0.1244	0.0631	.80
Rh_0rh	11	2.56	8	2.85	0.0507	Rh_0rh: Rh_1Rh_1	1.1326	+0.1244	0.0631	.80
rh″rh	7	1.63	5	1.78	0.0023	rh″rh: Rh_1Rh_1	1.1109	+0.1052	0.0297	<.90->.80
rhrh	35	8.16	22	7.83	0.0221	rhrh: Rh_1Rh_1	0.9761	—0.0243	0.0064	<.98->.95
Total	429		281		0.5784*					

* The probability for eight degrees of freedom is 0.99.

** The probability is for one degree of freedom.

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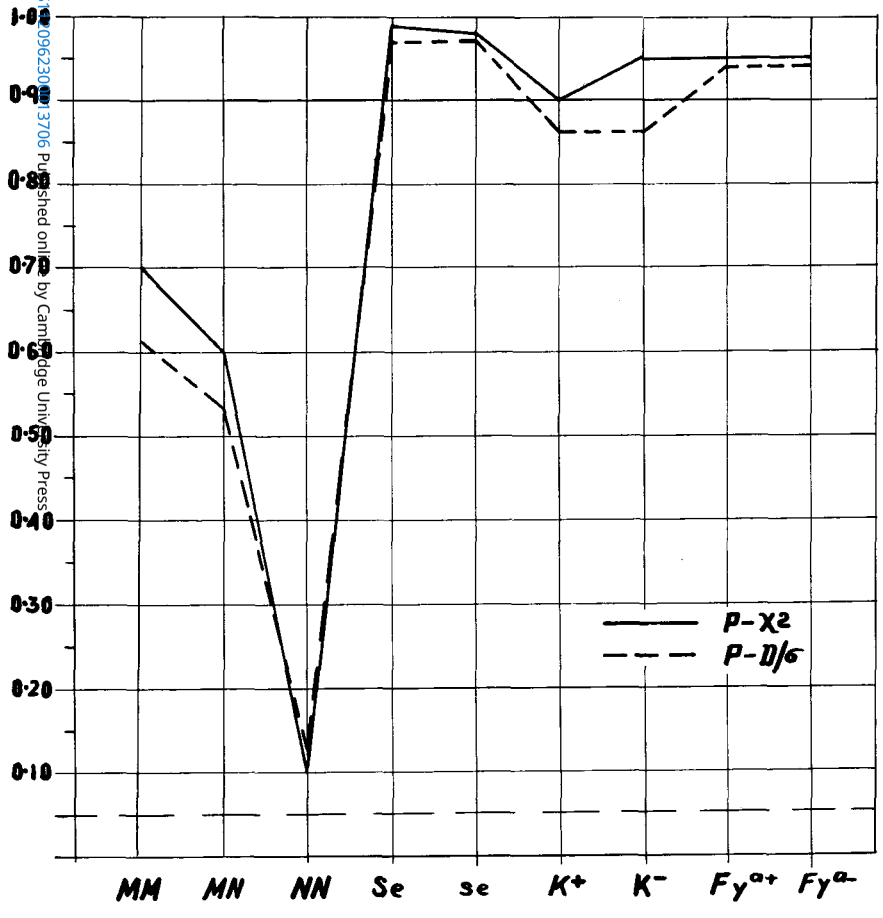

Fig. 2. Probability polygons of the χ^2 and the D/σ for the MN, secretor factor, Kell and Duffy blood groups

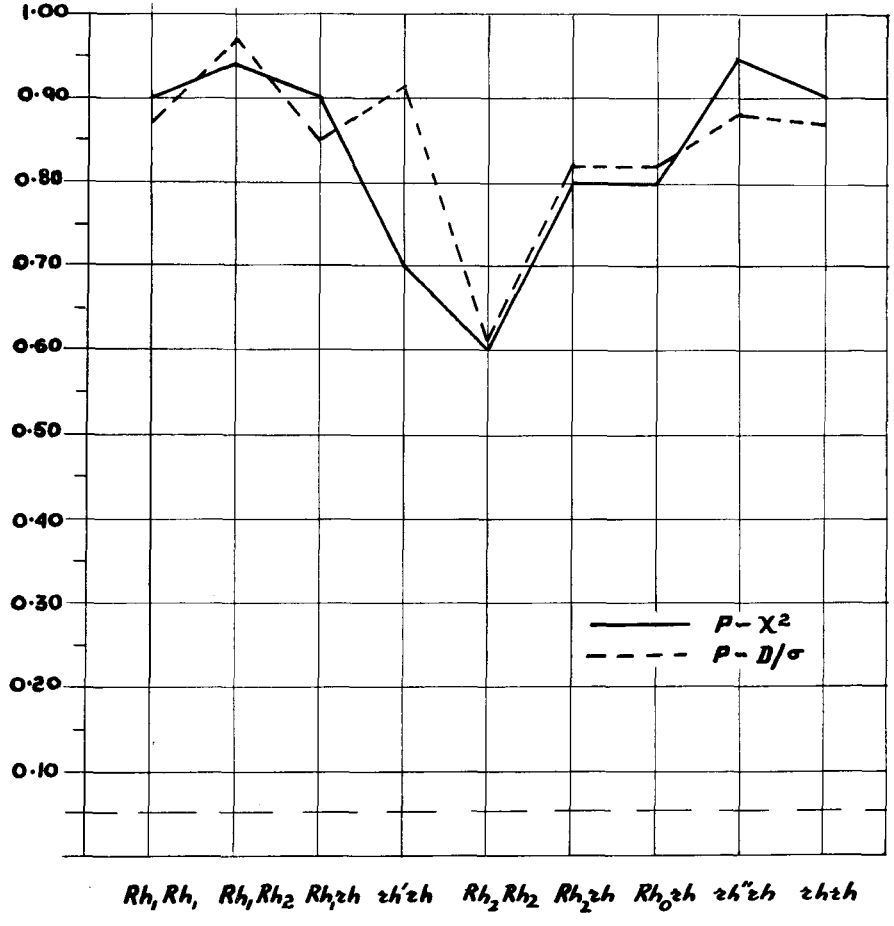

Fig. 3. Probability polygons of the χ^2 and the D/σ for Rh-factor

Tab. 8. The observed and expected numbers, variance and D/σ for the Rhesus phenotypes of the patients

Phenotypes	Obs. no. T(O)	Exp. no. T(E)	Variance ± σ	D/σ	Probability
Rh_1Rh_1	94.00	94.98	37.80 ± 6.1482	—0.1604	<.88->.98
Rh_1Rh_2	49.00	49.08	24.51 ± 4.9508	—0.0307	<.98->.97
Rh_1rh	84.00	85.09	35.80 ± 5.9833	—0.1824	<.86->.85
rh′rh	7.00	6.33	37.20 ± 6.0992	+0.1094	<.92->.91
Rh_2Rh_2	4.00	3.17	3.79 ± 1.9466	+0.4283	<.67->.66
Rh_2rh	8.00	7.52	4.42 ± 2.1024	+0.2284	<.82->.81
Rh_0rh	8.00	7.52	4.42 ± 2.1024	+0.2284	<.82->.81
rh″rh	5.00	4.75	2.82 ± 1.6793	+0.1493	<.89->.88
rhrh	22.00	22.56	12.55 ± 3.5426	+0.1578	<.88->.87

probabilities for D/σ range from 0.66 to 0.98, thereby indicating the absence of the association of filariasis with any of the genotypes. The values of probabilities obtained from the χ^2 (Tab. 7, part 1) and of D/σ (Tab. 8) from the normal deviations have been illustrated in Fig. 3, and thus confirm the nonsignificant difference obtained above of the distribution of the blood groups in the patients and the controls.

From the above results, no relationship can be deduced between A_1A_2BO, MN, Kell, Duffy and rhesus blood groups and secretor factor and filariasis. Therefore, no conclusion can be drawn regarding the susceptibility or resistance of one blood group over the other to filariasis, and the predominance of one site of lesion over another with regard to any of these blood groups.

Jennings et al. (1956) in a series of cases of gastric carcinoma opined that the excess of group A over O was due to an association between blood group A and carcinoma of pyloric end of the stomach; there being no excess of group A in carcinoma arising in the body of the stomach. Aird et al. (1954) found an excess of O in peptic ulcer, and Vachhrajani and Shenoy (1960), in a small series of peptic ulcer cases, found an increase in group O when compared to the ABO distribution of one of their controls, whereas when the same tested series was compared to their second control, it did not show any significant association between group O and peptic ulcer. Clarke et al. (1955) were not able to show any relationship between gastric ulcer and blood groups. This variability in the results obtained by different investigators might be coherent with (i) the size and reliability of the data; (ii) the correct diagnosis of the disease; and (iii) the different techniques applied for testing the blood groups.

Taking into account the above factors regarding the present analysis, it can be said that there is no association between blood groups and filariasis. The distribution of blood groups in the patients is similar to that found in the control series, except in MN blood groups, where the frequency of N is slightly higher in the patients series but the difference is not so great as to show any significant association with filariasis.

Summary

603 patients suffering from filariasis have been studied for A_1A_2BO blood groups; 281 for Duffy, Kell and rhesus blood groups; 178 for secretor factor; and 503 for MN blood groups, to find out if there is any association between filariasis and these blood groups. No association, whatsoever, has been found between the blood groups studied and filariasis.

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Literature

Aird I., H. H. Bentall & J. A. Roberts: A relationship between cancer of stomach and the ABO blood groups. Brit. Med. Jour., 1: 799, 1953.

— J. A. Mehigan & J. A. Roberts: The blood group in relation to peptic ulceration and carcinoma of colon, rectum, breast and bronchus. Brit. Med. Jour., 2: 315, 1954.

Anand S.: ABO blood groups in relation to eosinophilia. The Anthropologist, 8 (1-2): 33-39, 1961.

— The relationship of ABO, MN and Rhesus blood groups to asthma. Ind. Jour. Chest Dis., 6 (2): 74-79, 1964.

— Association of ABO blood groups with incidence of renal lithiasis. A.Ge.Me.Ge., 13 (2): 167-172, 1964.

Buckwalter J. A., G. S. Naifeh & J. E. Aner: Rheumatic fever and the blood groups. Brit. Med. Jour., 3: 1023, 1962.

Clarke C. A., W. K. Cowan, J. W. Edwards, A. W. Howell Evans, R. B. McConnell, J. C. Woodraw & P. M. Sheppard: The relationship of ABO blood groups to duodenal and gastric ulceration. Brit. Med. Jour., 2: 643, 1955.

— J. W. Edwards, D. R. W. Haddock, A. W. Howel Evans, R. B. McConnell & P. M. Sheppard: The ABO blood groups and secretor character in duodenal ulcer. Brit. Med. Jour., 2: 725, 1956.

Dunfsord I. & C. C. Bowley: Blood grouping techniques. Oliver and Boyd. London, 1956.

Fisher R. A. & F. Yates: Statistical tables for biological, agricultural and medical research. 44-49. Hafner publishing Co. Inc., New York, 1953.

Jennings D., R. H. Blame & J. E. Richardon: Carcinoma of stomach in relation to ABO blood groups. Lancet, 2: 11, 1956.

Lewis J. G. & A. C. Woods: The ABO and rhesus blood groups in patients with respiratory disease. Tubercle, 42 (3): 362, 1961.

Navani H. & R. K. Narang: A study of ABO blood groups in pulmonary tuberculosis. Ind. Jour. Chest. Dis., 4 (2): 109, 1962.

Penrose L. S.: Recent advances in human genetics. 145-149. J. & A Churchill Ltd., London, 1961.
Roberts J. A.: Association between blood groups and disease. A. Ge. Me. Ge., 19 (4): 549-560, 1956/57.
Shenoy M. A. & V. G. Daftary: ABO blood group and pulmonary tuberculosis. Ind. Jour. Med. Sc., 16 (6): 493, 1962.
Vachhrajani R. B. & M. A. Shenoy: Study of ulcer dyspepsia with a note on its relation to ABO blood groups. Jour. J. J. Hosp. G.M.C., 5: 83, 1960.
Woolf B.: On estimating relation between blood group and disease. Ann. Hum. Genet., 19: 251-253, 1955.

RIASSUNTO

Sono stati studiati i gruppi sanguigni in individui affetti da filariosi: 603 pazienti per A_1A_2 BO, 281 per Duffy, Kell ed Rh, 503 per MN e 178 per il fattore secretore. Fra i gruppi studiati e la filariosi non è risultato esservi alcun tipo di correlazione.

RÉSUMÉ

Des patients de filariose ont été étudiés, 603 pour les groupes A_1A_2BO, 281 pour les groupes Duffy, Kell et Rh, 503 pour les groupes MN et 178 pour le facteur secréteur. Aucune association n'a été trouvée.

ZUSAMMENFASSUNG

Bei Filariosispatienten wurden die Blutgruppen untersucht: 603 Patienten der Blutgruppen A_1A_2BO, 281 der Gruppen Duffy, Kell und Rh, 503 der Blutgruppe MN und 178 Patienten des Sekretorenfaktors.

Es hat sich keinerlei Zusammenhang zwischen den untersuchten Blutgruppen und der Filariosis ergeben.