ABO AND RH BLOOD GROUPS AMONG THE PRIMARY INFERTILE AND THE FERTILE FEMALES

by

R. N. Nag,* M.B.B.S., D.Phil. (Cal.), F.R.C.O.G, (Lond.)

and

A. R. Banerjee,** M.Sc., D.Phil. (Cal.)

Significance of blood groups in the natural selection in the man has been studied in recent years by Waterhouse and Hogben (1947), Allan (1953), Bryce *et al* (1950), Kirk *et al* (1955), and Matsunaga and Itoh (1953, 1955). It has now been fairly well established that heterozygotes of Rh(D) types are found in all the fatal cases. Incompatibility in the ABO matings is also responsible for the loss of children through miscarriage and haemolytic disease (Levine, 1943, 1958). Recently, Roy (1969) noted the incidence of Rh iso-immunisation in the frequency of 1 in 1027 total pregnancies and 1 in 21 among the Rh negative mothers. Besides that the suggestion of Hirzfeld and Zborowski (1925), that the serological incompatibility might be a cause for infertility has in recent years been studied by Behrman *et al* (1960), with some positive evidence for it. Solish *et al* (1969) however, observed some negative evidence and on statistical grounds contradicted the findings of Behrman *et al* (1960). Dukes and Franklin (1968), Boettcher (1968), and Isojima and Tsuzuku (1968), tried to find out reasons for human infertility on the basis of sperm agglutinins and anti-spermatozoal activity on the female serum.

In spite of all the works mentioned above our knowledge with regard to serological incompatibility and infertility is not yet very clear, and consequently it is yet to be known thoroughly whether the difference in blood groups between the couples can be accounted for as a contributory factor in the causation of disturbed fertility.

With this end in view, an attempt has been made to find out the association of blood groups and the reproductive performance of the couple, and for that purpose ABO and Rh blood groups of the primary infertile and the fertile females were studied.

Material and Method

Since 1966, ABO and Rh blood groups of female patients attending the antenatal and the infertility clinics of the hospital were determined in the genetic laboratory. Two years of continuous co-habitation after marriage without conception

**Visiting Obstetrician & Gynaecologist, Ramakrishna Mission Seva Pratishthan.*

***Lecturer in Anthropology, Calcutta University, and Officer-in-Charge, Human Genetic Laboratory, Ramakrishna Mission Seva Pratishthan, Calcutta.*

Received for publication on 11-2-1970.

was taken as a criterion for primary infertility.

Patients were generally requested to come with their husbands. A detailed biological history from both the partners was recorded in a scheduled chart prepared for the purpose. Nearly 2 ml of blood was drawn from each of the partner by vein puncture. The samples were tested according to standard methods (Boorman and Dodd, 1957). Due to non-availability of all the anti-sera for Rh types in a regular manner, in the majority of cases only Rh(D) types was determined. Nearly 80% of the population included in the present study came from the Bengalee parentage. Detailed studies of the endometrium, vaginal cytology, sex-chromatin from buccal smear and semen analysis were also undertaken in infertile couples, the results of which will be published subsequently elsewhere. The work is still being continued. In the present communication, however, only the preliminary findings on the distribution of ABO and Rh(D) blood groups have been reported, the detailed analyses will be communicated subsequently.

Analysis

Distribution of ABO and Rh(D) blood groups among the 271 primary infertile, 218 normal fertile couples and 493 women whose last children were affected with neonatal jaundice has been presented in Tables 1 and 2 respectively. It will be noted that in the last group husbands of all women were not available; only 73 husbands from this group were available for investigation.

It will be apparent from the Table 1 that the frequency of O group is slightly higher while the frequency of B group is slightly lower among the female than in their respective male counterparts. But the difference between the male and the female with regard to the ABO frequency distribution is not statistically significant among both the primary infertile and

TABLE I

Distribution of ABO blood groups among the primary infertile and the fertile couples

Group	Sex	O	A	B	AB	Total	X^2 (3 d.f.)
1. Primary infertile	Female	95	63	87	26	271	1.01
	%	35.05	23.25	32.10	9.59		
	Male	85	63	96	27	271	.8> P> .7
	%	31.37	23.25	35.42	9.97		
2. Fertile	Female	71	56	73	18	218	
	%	32.57	25.68	33.49	8.26	218	3.88
	Male	62	45	91	20		
	%	28.44	20.64	41.74	9.17		.3> P> .2
3. Fertile with child affected with neonatal jaundice.	Female	182	101	156	54	493	
	%	36.92	20.49	31.64	10.95		8.82
	Male	15	23	25	10	73	.05> P> .02
	%	20.55	31.51	34.25	13.70		
Total	Female	348	220	316	98	982	
	%	35.44	22.40	32.13	9.98		
	Male	162	131	212	57	562	8.07
	%	28.82	23.31	37.72	10.14		.15> P> .07

TABLE II

Distribution of Rh (D) blood groups among the primary infertile and the fertile couples

Group	Sex	Rh(D)	Rh(D)	Total	X^2 (Id. f.)
1. Primary infertile	Female	251	20	271	
	%	92.70	7.70		2.09
	Male	258	13	271	
	%+	95.21	4.79		.2> P> .1
2. Fertile	Female	196	22	218	
	%	89.91	10.09		1.93
	Male	204	14	218	
	%	93.58	6.42		.2> P> .1
3. Fertile with child affected with neo-natal jaundice.	Female	476	17	493	
	%	96.58	3.44		0.14
	Male	70	3	73	
	%	95.90	4.10		.95> P> .9
Total	Female	923	59	982	
	%	94.00	6.00		.30
	Male	532	30	562	
	%	94.67	5.33		.70> P> .50

the normal fertile couples. Women having children affected with neo-natal jaundice show, however, some difference in the distribution of ABO frequencies from those of their husbands, and consequently when the data were pooled according to the sex, the difference was found to be reflected and seen to be reaching the level of statistical significance.

In the distribution of Rh(D) frequencies (Table II), although females are found to possess slightly higher number of Rh (D)-type than their respective male counterparts among the primary infertile and the normal fertile couples, in neither of the cases nor even in the pooled data the difference in the distribution of Rh(D) frequencies between husbands and wives, is found to be statistically significant.

Behrman *et al* (1960) observed a high incidence (87.30%) of incompatible ABO matings among the infertile couples, while among the fertile couples the incidence of incompatible matings was found to be 38.60%. The incidence of ABO and Rh(D) incompatible and compatible mating types among the primary infertile and fertile couples of the present sample has been worked out according to Levine (1958), and has been presented in Tables III and IV respectively.

It will be quite apparent from these tables that the primary infertile and the fertile couples do not show any appreciable difference in the percentage occurrence of the compatible and the incompatible mating types with regard to both the ABO and Rh(D) blood groups.

Consistancy in ABO gene frequencies, calculated after Bernstein (1925), among the females of the present study can be noted when comparisons are made among the primary infertile, the fertile, and the fertile females with children affected with neo-natal jaundice (Table 5). Low X^2 values of the comparison point to a homogeneity among the

TABLE III

ABO mating types among the primary infertile and the fertile couples

ABO mating types Male—Female	P. Infertile		Fertile		Total	
	No.	%	No.	%	No.	%
Compatible						
0—0	28	18.18	23	19.82	51	18.89
0—A	25	16.23	11	9.48	36	13.33
O—B	25	16.23	22	18.96	47	17.41
O—AB	7	4.48	6	5.17	13	4.81
A—A	15	9.66	13	11.22	28	10.37
A—AB	7	4.48	2	1.72	9	3.33
B—B	35	22.42	29	25.00	64	23.70
B—AB	9	5.79	8	6.90	17	6.33
AB—AB	3	1.93	2	1.72	5	1.85
Total	154	56.82	116	53.16	270	55.21
Incompatible						
A —0	21	17.64	11	10.78	32	14.61
B —O	34	20.51	27	26.47	61	27.85
AB—O	12	10.26	10	9.80	22	10.04
AB—A	5	4.10	5	4.90	10	4.56
AB—B	7	5.88	3	2.94	10	4.56
A—B	18	15.29	27	26.47	20	20.55
B—A	20	20.41	19	18.63	29	17.81
Total	117	43.18	102	46.84	219	44.79
All total ..	271		218		489	

TABLE IV

Rh(D) mating types among the primary infertile and the fertile couples

Rh (D) mating types Male—Female	P. Infertile		Fertile		Total	
	No.	%	No.	%	No.	%
Compatible						
Rh(D) + — Rh (D) +	242	94.90	184	92.93	426	94.04
Rh (D) — — Rh (D) +	9	3.53	12	6.06	21	4.64
Rh (D) — — Rh (D) —	4	1.57	2	1.01	6	1.32
Total	255	94.09	198	90.83	453	92.64
Incompatible						
Rh (D) + Rh (D) —	16	5.91	20	9.17	36	7.36
All total	271		218		489	

TABLE V

ABO gene frequencies in % among the Bengalee Females

Groups	N	P	q	r	Author	X^2 (.df..—3)
1. Primary infertile	271	17.97	23.54	58.49	Present study	.78
2. Fertile	218	18.78	23.74	57.48	,, ,,	.9> P> .8
3. Fertile with child affected with neonatal jaundice.	493	17.02	23.97	59.01	,, ,,	3.90 .3> P> .2
4. Total female	982	17.57	24.67	57.75	Present study	11.19
5. Fertile* Female	2200	16.25	25.68	58.07	Sen et. al. (1959)	.02> P> .0

*Recalculated after Bernstein's clorrection (1925).

female with regard to the ABO blood group distribution. Pooled ABO frequencies of the present female sample are, however, found to differ significantly from the ABO frequencies found by Sen *et al* (1959) among the fertile Bengalee females.

In the distribution of Rh(D) frequencies, a somewhat different picture than those of the ABO ones is noted. Among the primary infertile and the fertile females no statistical significant difference in Rh(D) frequencies can be observed (Table 6); but the fertile females of the present sample are found to possess the highest frequency of *d* gene and consequently they are found to stand in statistically significant difference from the female with child affected with neonatal jaundice. When comparisons are made between the weighted average of Rh(D) frequencies of the present female sample and the Rh(D) frequencies as found by Sen *et al* (1959), among the Bengalee females, the samples, similar to the ABO gene frequencies, are found to be statistically highly differentiated. (Table 6).

Discussion

It will be apparent from the foregoing analyses that a clear association between the ABO incompatible mating types and the infertility, as found by Behrman *et al* (1960), is not very much evident from the present investigation. Rh(D) mating types, too, appear not to be playing any significant part in the causation of infertility. Lack of difference in the distribution of ABO and Rh(D) blood groups between the husband and the wife among the primary infertile and the normal fertile couples is also quite apparent from the present data. Fertile females with children affected with neonatal jaundice, however, show statistically significant difference in the distribution of ABO frequencies from those of their husbands. When comparison is made between the pooled ABO data of the husband and those of the wife, distortion in the distribution of ABO frequencies can be found. How much of this distortion is due to the inequality of the comparable samples and how much of it is due to some biological fact is difficult to find out at this stage on the basis of such small sample.

Incidences of the compatible and the incompatible mating types with regard to both the ABO and Rh(D) blood groups were found to be almost the same among both the primary infertile and the normal fertile couples. The above findings do not stand in conformity with those of Behrman

TABLE VI

Rh (D) gene frequencies in % among the Bengalee females

Group	N	D	d	Author	X^2 (d.f.-3)
1. Primary infertile	271	72.99	27.01	Present study	1.07
2. Fertile	218	68.24	31.76	„ „	P = .30
3. Fertile with child affected with neo-natal jaundice.	493	79.76	20.24	„ „	12.89 P> .001
4. Total female	892	73.66	26.34	Present study	32.80
5. Fertile female	2200	82.68	17.32	Sen et. al. (1959)	P> .001

et al (1960), but some agreement with the findings of Solish and Gershowitz (1969) has been found in the present investigation.

Consistancy in the distribution of ABO gene frequencies among the primary infertile, the normal fertile and the fertile females with children affected with neonatal jaundice points to a genetic similarity among the females of the present investigation. Some amount of inconsistancy, however, has been found with regard to the distribution of Rh(D) types among the three categories of the female included in the present study. The female with a child affected with neontal jaundice shows a lesser frequency of *d* gene than that of the fertile and the primary infertile females. Consequently the Rh(D) distribution in the former category was found to be statistically significant different from the primary infertile (X^2-5.82, d.f.-1, $P > .02$) and also from the normal fertile (X^2-12.89, d.f.-1, $P > .001$) females.

The pooled data for the ABO distribution as well as weighted average for the Rh(D) types of the present females when compared with those of the Bengalee female sample published earlier by Sen *et al* (1959), the data of the comparable samples are found to be differentiated. Similar data for the fertile Bengalee males were not available for comparison. The reason for the inconsistancy between the present sample and the sample of Sen *et al* (1959) with regard to both the ABO and Rh(D) distributions is difficult to be explained as nothing is known about the results of pregnancies of the females samples utilized by Sen *et al* (1959).

The absence of positive correletion between the incidence of incompatible matings and the primary infertility as evidence in the present study need not necessarily be accounted for the negative evidence for selection. Only a fraction of the couples included in the present study have completed their reproductive performances and reached the end of their reproductive period. And hence, further work with much more data on these lines is necessary to know the facts more clearly.

Summary

The effect of serological incompatibility on fertility was studied in a population of 1544 individuals comprising the normal fertile couples, the primary infertile couples and women with children affected with neonatal jaundice. Nearly 80% of the individuals belong to Bengalee parentage. The distribution of ABO and Rh(D) blood groups was estimated from the population. The incidence of ABO and Rh(D) mating types was found to be almost equal among both the primary infertile and the fertile couples. No discrepancy was found in the distribution of ABO and Rh(D) blood groups among the husband and the wife. Consistancy in the distribution of ABO gene frequencies among the fertile and the infertile females points to the genetic homogeneity among the females of present investigation. The present sample, however, found to be differentiated from the published report on the fertile Bengalee female.

It is concluded from the above mentioned studies that further work with much more data from the coples with completed reproductive performances are necessary to arrive at the

possitive conclusion with regard to the relationship between the serological incompatibility and fertility.

Acknowledgement

Authors are much indebted to the authorities of the Ramakrishna Misson Seva Pratishtan, Calcutta, for extending all necessary facilities to continue the work.

References

1. Allan, T. M.: Brit. J. Prev. Soc. Med. **7**: 220, 1953.
2. Behrman, S. J., Buettner-Janausch, J., Heglar, R., Gershowitz, H. and Tew, W. L.: ABO(H) incompatibility as a cause of infertility: a new concept. Am. J. Obst. & Gynec. **79**: 847, 1960.
4. Boettcher, B.: J. Reproduct. Fert. **16**: 49, 1968.
5. Boorman, Kathleen E. and Dodd, Barbara, E.: An Introduction to Blood Group Serology, London, 1957, Churchill.
6. Bryce, L. M., Jakobowicz, R., McArthur, N. and Penrose, L. S.: Ann. Eugen. **15**: 271, 1950.
7. Dukes, C. D. and Franklin, R. R.: Fertil. and Steril. **19**: 263, 1968.
8. Hirzfeld, L. and Zzorowski, H.: Klin. Wschr. **4**: 1152, 1925.
9. Isojima, S. and Tsuzuku, O.: Antibody on Spermatozoa. Am. J. Obst. & Gynec. **102**: 304, 1968.
10. Kirk, R. L., Kirk, M. and Steinhouse, N. S.: Brit. J. Prev. Soc. Med. **7**: 1, 1953.
11. Kirk, R. L., Shield, J. W., Steinhouse, N. S., Bryce, L. M. and Jakobowicz, R.: Brit. J. Prev. Soc. Med. **9**: 194, 1955.
12. Levine, P.: Heridity. **34**: 71, 1943.
13. Levine, P.: Hum. Biol. **30**: 14, 1958.
14. Matsunaga, E. and Itoh, S.: Proc. Jap. Acad. **29**: 399, 1953.
15. Matsunaga, E. and Itoh, S.: Ann. Hum. Genet. **22**: 11, 1955.
16. Roy, M. N.: J. Obst. & Gynec. India. **19**: 331, 1969.
17. Sen, N. N., Mukerjee, C. L. and Aikat, B. K.: J. I. M. A. **33**: 210, 1959.
18. Solish, G. I. and Gershowitz, H.: Am. J. Hum. Genet. **21**: 23, 1969.
19. Waterhouse, J. A. H. and Hogben, L.: Brit. J. Soc. Med. **1**: 1, 1947.