

## MATERNAL FOETAL INCOMPATIBILITY AND ANTIBODY TITRES IN ABO BLOOD GROUPS

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### SUMMARY

Blood samples from 176 mothers and cord blood of their neonates were analysed for the ABO blood groups and titres of the antibodies with a view to study levels of natural antibodies in ABO compatible and incompatible maternal foetal groups.

The distribution of ABO blood in mothers and neonates was found to be more or less similar to that found in the local population. The frequency of male births was more than that of female births in all the blood types and was also higher when the blood groups of their mothers were compatible than when incompatible. It was observed that group A mothers could accommodate an incompatible B foetus more efficiently than group B and O mothers with A and A or B foetus respectively. Further in majority of group A mothers (53.3%) the anti-B titres was found to be at medium levels suggesting that the low titres of anti-B could have offered greater tolerance to group A mothers with group B foetuses.

The low frequency of incompatible children born to group B mothers suggests that they may be less tolerant to such children and the anti A titre in 75% of cases was found to be high ( $\geq 1:1256$ ) which might have caused incompatibility and foetal loss leading to low frequency of children with incompatible blood groups.

There was also variation in the anti A and anti B titres found in group A and B mothers as compared to anti A and anti B titres found in group O mothers.

In general antibody titres were found to be low in cord samples as compared to that in the maternal samples indicating low immunoglobulin production in the new born. The scope of further studies on similar lines is discussed based on the present results.

**Key words :** ABO blood groups, maternal foetal incompatibility anti-body titres.

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## INTRODUCTION

Haemolytic disease of the new born is an outcome of maternal foetal interactions resulting due to genetically determined immunological incompatibilities. Immunological incompatibility results when the major blood group antigens in foetus differ from that of their mothers. In such cases the maternal antibodies haemolyse the red blood cells of the foetus causing haemolytic anaemia which is usually observed in Group A and B infants born to Group 'O' mothers (Dhamgaye and Gurtu 1987). Most of the anti-A and anti-B produced are Ig-M molecules which in pregnancy do not cross the placenta. These molecules usually change to IgG class within few weeks or months when exposed to a different blood group. In certain adults with group O the naturally occurring anti-A and anti-B and anti-AB (a cross reacting antibody called anti-C) are of Ig G type which cross the placenta and destroy the foetal cells (Giblett 1983). Hence haemolytic disease in the new born is more often seen in Group A and B infants born to 'O' mothers, when compared to other maternal-foetal incompatible combinations.

Research conducted on ABO Blood groups have mostly been on the population variations and estimation of risk a person runs for a disease with a specific blood group (Giblett 1969; Mourant et al 1978). Few attempts were made to study the level of anti-A and anti-B titres which were found to vary with age, (Thomson and Kettel 1929) sex (Dutta and Roy 1967, Shanbagh et al 1973) different blood groups (Roy and Bhalla 1979) allergic conditions (Callender and Race 1946)

repeated transfusions (Dutta and Roy 1973) and immunological tolerance (Jacobwitz et al 1959). Such information is not available in case of maternal foetal incompatibility for ABO system. Since risk of anemia and foetal loss is likely to depend on the extent of natural antibodies present in mothers, an attempt is made to study the effect of anti-A and anti-B titres in the blood of mothers and the cord blood of their infants with compatible and incompatible blood groups.

## MATERIAL AND METHODS

Cord blood samples of 176 new born infants and blood samples from their mothers who were admitted to Andhra Mahila Sabha Hospital, Hyderabad were collected to determine their blood groups and the titres of the corresponding antibodies in their serum obtained after clot retraction. The samples collected were from mothers who had normal delivery and pregnancy without the history of diabetes, hypertension, epilepsy Gynaecological pathology etc. Similarly the cord blood samples were collected from infants without any significant clinical symptoms.

From each blood samples serum was separated after clot retraction and subjected to the determination of titres for antibody A and B in Group A, B and O individuals. From the blood clotted, RBCs were obtained by dislodging the clot gently and washed thrice with buffered saline. Then 2% cell suspensions were prepared with the buffered saline and used for the typing of ABO blood groups with Ethnor antisera.

After determining the blood groups, the serum samples were serially diluted

with buffered saline to obtain dilutions ranging from 1:1 to 1:2048. To each of the dilutions so prepared equal volume of 2% suspensions of washed red cells either A or B depending on the antibody being tested was added. After thorough mixing the suspension was allowed to stand in the tubes for 30 minutes. A saline control was maintained simultaneously to compare with the test samples. Later results were noted after mild centrifugation for 30 seconds based on the agglutination in the tubes both macroscopically and microscopically. Serum dilution which produces last visible trace of agglutination was recorded as the titre of the antibody and analysed for the variation in titres in mothers and cord blood of their infant with compatible and incompatible groups.

### RESULTS AND DISCUSSIONS

In the present study the distribution of ABO blood groups were found to be more or less similar in the mothers

(A = 26.1%, B = 34.1%, O = 39.8%, AB = 0.0%) and cord blood of their neonates (A = 27.8%, B = 32.4%, O = 34.6%, AB = 5.1%, Table I) as compared to the distribution found in the local population by Padma and Murty (1974) (A = 23.8%, B = 33.6%, O = 35.8% and AB = 6.8%). Among the neonates born, there was preponderance of male infants (males = 63.1% and females = 36.9%) which is in accordance with the generally observed high frequency of male births in most of the populations. A high frequency of male births was observed in neonates in all the blood groups, the frequencies being, A = 61.0%, B = 64.3%, O = 62.9% and AB = 66.7% in males as against A = 39.0%, B = 35.7%, O = 37.1% and AB = 33.3% females.

It is interesting to note that Group A mothers gave birth to Group B infants (32.6%) as frequently as Group A infants (34.8%) in spite of the fact that Group B foetus is incompatible with Group A mothers. This indicates that Group A

Table I

ABO Blood group frequencies in mothers and cord blood of their neonates

Mothers	Neonates								Total
	Group A		Group B		Group O		Goup AB		
	n	%	n	%	n	%	n	%	
Group A	16	34.8	15	32.6	10	21.7	5	10.8	46 (26.1)
Group B	16	26.7	26	43.3	14	23.3	4	6.7	60 (34.1)
Group O	17	24.3	16	22.8	37	52.8	—	—	70 (39.8)
Group AB	—	—	—	—	—	—	—	—	—
Total	49	—	57	61	61	—	9	—	176
		(27.8)		(32.4)		(34.6)		(55.1)	

Figures in parenthesis is the frequency of blood groups in mothers and the neonates

mothers could accommodate an incompatible group B foetus more efficiently than Group B or O mothers (Table I). It is possible that the titres of anti-B in Group A mothers might be too low to cause selection against group B foetus, in early stages of pregnancy or at prezygotic level.

In the present study out of the 176 mother-child pairs examined incompatibility for ABO groups was observed in 41.5% cases, (Table II) the incompatibility recorded being highest when the mothers had group O (47.2%) followed by group A (43.5%) and group B (27.4%). This suggests that group B mothers were less tolerant to foetus with incompatible blood group as compared to mothers with group A and O. In other words the strength of anti-A present in group B mothers may be quite high to cause foetal loss and consequently low frequency of birth of children with incompatible blood group.

It may be observed further that the sex ratio was roughly 3:2 in neonates born to mothers of different blood groups in compatible mother-child combination while this ratio varied among neonates born to mothers with different blood groups when the combination was incompatible.

It was observed that the frequency of male infants was higher when they were born to mothers with compatible blood groups compared to the mothers with incompatible blood groups (Table II). This frequency varied in case of female infants born to mothers with compatible and incompatible groups. This finding suggests that foetal loss of male infants could be more when the mothers had in-

Table II  
Sex-wise distribution of compatible and incompatible offsprings born to Group A, B and O Mothers

	Compatible offspring						Incompatible offspring						Total offspring	
	Males		Females		Total		Males		Females		Total		n	%
	n	%	n	%	n	%	n	%	n	%	n	%		
Group A	17	65.4	9	34.6	26	(56.5)	11	55.0	9	45.0	20	(43.5)	46	
Group B	25	62.5	15	37.5	40	(66.7)	14	70.0	6	30.0	20	(27.4)	60	
Group O	26	70.3	11	29.7	37	(52.8)	18	54.5	15	44.5	33	(47.2)	70	
Total	68	66.0	35	34.0	103	(58.5)	43	58.9	30	41.1	73	(41.5)	176	

Figures in parenthesis are the percentage of compatible and incompatible offsprings over total offsprings born to mothers with A, B and O blood groups.

compatible groups.

Frequency distribution of the anti-A and anti-B titres in group A, B and O mothers and cord blood of their neonates were obtained. Since the frequencies with certain titres were low for comparisons, the samples were categorised into three groups i.e. those which (a) low titres ( $\leq 1:18$ ) (b) medium titres (1:16 to 1:128) and (c) high titres ( $\geq 1:256$ ). From this grouping (Table III) it was observed that among mothers with both compatible and incompatible children, majority had medium titres for anti-A and anti-B when the blood groups in mothers were A, B and O. The exception observed was that the frequency of group B mothers with high titres of anti-A was higher (75.0%) than those with medium titres (25.0%) when they happen to carry children with incompatible blood groups. This explains the low frequency of incompatible children (with group A-26.7%, with group O-23.3% Table I) born to group B mothers possibly due to higher rate of elimination of infants at foetal level. Similarly the high frequency of group

A mothers (93.3% Table IV) with medium anti-B titres in their serum explains the high rate of tolerance of group A mothers to group B foetus as evident from the high frequency of group B children (32.6%) born to group, A mothers in the present study (Table I).

Between compatible and incompatible maternal foetal combinations, as expected, the frequency of mothers with high titres were significantly low in incompatible combinations as compared to compatible combinations. In general anti-B titres was found to be low in greater proportion of group A mothers as compared to anti-B titres in group O mothers both when the maternal foetal combination were compatible and incompatible (Table III).

When the antibody titres in the cord blood of neonates with compatible mothers was analysed the frequency of anti-A antibodies with high titres was found in group B (42.8%) as compared to group O (18.0%) cord samples. In case of anti-B this was reverse where the frequency of anti-B with high titres was very low in group A (18.7%) cord sample

Table III

Frequency of compatible and incompatible offsprings born to mothers with different blood groups

Mothers	No	Male offspring				No	Female offsprings			
		Compatible		Incompatible			Compatible		Incompatible	
		n	%	n	%		n	%	n	%
Group A	28	17	60.7	11	39.3	18	98	50.0	9	50.0
Group B	39	25	64.1	14	35.9	21	15	71.4	6	28.6
Group O	44	26	59.1	18	40.9	26	11	42.3	15	57.7
Total	111	68	61.3	43	38.7	65	35	53.8	30	46.1

Table IV

Titers of ABO blood group antibodies in mothers and cord blood of neonates based on compatible and incompatible maternal foetal combinations

	N	Compatible combinations		N	Incompatible combinations		
		1:18 %	1:128 to 1:256 %		1:18 %	1:128 to 1:256 %	
<b>In mothers</b>							
Group B (anti A)	40	5.0	57.5	16	—	25.0	75.0
Group A (anti B)	26	11.5	53.8	15	—	93.3	6.7
Group O (anti A)	37	5.4	54.1	33	—	87.9	12.1
(anti O)	37	5.4	48.6	33	6.1	60.6	33.3
<b>In neonates</b>							
Group B (anti A)	26	3.8	53.8	31	—	80.6	19.3
Group A (anti B)	16	6.3	75.0	23	3.0	57.6	39.4
Group O (anti A)	61	1.6	80.3	—	—	—	—
(anti B)	61	9.8	62.3	—	—	—	—

as compared to group 0 (27.9%) cord samples. When the titres in neonates with incompatible mothers was considered a high frequency was found in cases with high titre of anti-B (39.4%) as compared to anti-A (19.3%). In general the antibody titres was found to be lesser in cord blood samples as compared to those in their mothers. This may be due to the fact that immunoglobulin production is minimal in the new born leading to low levels of anti-A and anti-B in their sera.

The variations in the antibody levels as found in the present study may also be influenced by factors like gravidity gestation, parity, immune responses, placental permeability and genetic factors controlling inheritance, production and maintenance of antibodies in mothers bearing compatible and incompatible children. Further studies of these factors and also clinical evaluation of the new born for symptoms of haemolysis may provide better insight into the problem.

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