A STUDY OF THE P BLOOD GROUP SYSTEM IN THE SINGAPOREAN POPULATION

T C Mohan, W H Koo, H W Ng

ABSTRACT

The P blood-group system was discovered by Landsteiner and Levine (1) in 1927.

This study delineates:

a) The ethnic group specific distribution patterns of the P1 blood group antigen in the population of Singapore.

b) The occurence rate of the anti-P1 antibody in the same population.

In the blood donor population, the estimated incidence of the P1-negative phenotype was calculated to be 75%. Though the percentage of P1-negative individuals among the Chinese did not differ significantly from that for the Malays, it was significantly higher than that for the Indians ($P<0.01$).

The weighted average incidence of anti-P1 in the blood-donor population over the period 1982-1987 was calculated to be 9.14 per 100,000. For the patients, the average incidence of the anti-P1 antibody was calculated to be about 13.9 per 100,000 patients.

The Malays were noted to have the highest incidence of anti-P1 antibody despite the occurrence of a higher proportion of P1-negatives among the Chinese.

Key Words: P Blood Group System, Irregular Antibodies.

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INTRODUCTION

The P blood-group system was discovered by Landsteiner and Levine (1) in 1927 when they demostrated a new blood group specificity and found it to be a strong, genetically controlled, human red cell character. This new antigen was observed on the erythrocytes of about 80% of individuals who were designated P+, whereas those without it were termed P-.

Much work since the early 1950s (2,3) led to the serologic and genetic enlargement of the original P system: the P+ phenotype became P1, whereas the P- phenotype changed to P2, and anti-P was renamed anti-P1. Thus the simple P system evolved into a complex one, comprising three antigens (P1, P and Pk) and five red cell phenotypes (P1,P2,P,P1k and P2k).

Anti-P1 is usually a naturally occurring cold agglutinin in P1-ve individuals. Occasionally, these antibodies may be seen to be reactive at 37°C or in the presence of anti-human globulin.

The purpose of this study is to delineate:

Department of Pathology
Singapore General Hospital
Outram Road
Singapore 0316

T C Mohan, MBBS,
Medical Officer

Department of Haematology
Singapore General Hospital
Outram Road
Singapore 0316

W H Koo, MBBS, MRCP (UK),
Registrar
H W Ng, MBBS, M Med (Int Med),
Consultant

Correspondence to: Dr T C Mohan

a) The ethnic group specific distribution patterns of the P1 blood group antigen in the population of Singapore.

b) The occurrence rate of the anti-P1 antibody in the same population.

MATERIALS AND METHOD

The ideal method of defining the phenotypic distribution of this antigen in our population would have been to do prospective P1 phenotyping for sufficiently large numbers of Chinese, Malay and Indian individuals. As this consumes time and antisera use was made of P1 phenotyping that had already been done over the whole of 1987 at the Serology department of our blood bank at the Singapore General Hospital. In response to patients with anti-P1 antibodies who required blood, our blood bank would have to secure donor blood that lacks the P1 antigen. Blood units were usually picked at random for screening for their P1 status in order to locate compatible blood units. In the process, the technician makes a manual documentation of the total number of units picked up for screening and the actual number found to be P1 negative. This fraction, then, is an estimate of the overall frequency of the P1 phenotype in our donor population. In addition, by tracing back the ethnic group of the donors, ethnic group specific phenotypic frequencies were also determined.

Antisera for P1 phenotyping were obtained from Ortho Diagnostics (USA) and Biotest (Germany).

Both the blood donors and the patients requiring blood were routinely screened for the presence of any irregular antibodies using standard panels of red cells. Identification of antibody specificities were performed using carefully selected panels of red cells obtained from Ortho Diagnostics (USA), Biotest (Germany) and Biological Corporation of America.

Statistics were collected to define:

a) the antibody occurrence rates observed among our blood donors during the period 1982-1986.

b) the anti-P1 prevalence patterns among patients in the period 1982-1987. These patients were from all government and private hospitals in Singapore as our blood bank served as a reference laboratory for all these hospitals.

c) any correlations to the their ethnic identities or underlying clinical conditions.

RESULTS

Over the whole of 1987, in response to all the patients detected to harbour anti-P1, a cumulative total of 96 blood units were picked up at random for screening. As Table 1 shows, of this 72 were indeed found to be P1-negative. Thus in our blood donor population the estimated incidence of the P1-negative phenotype is 75% (i.e. 72/96). The ethnic groups of these 72 P1-negative donors were easily traced back using the blood-pack identification numbers as the database search-keys. The ethnic origins of the donors of the 96 blood units picked up randomly were expected to parallel the ethnic distribution characteristic of the blood donor population in 1987. Thus, using these 2 sets of figures, the frequency of the P1-negative phenotype was determined for each of the 3 main ethnic groups of Singapore (Table 1).

Though the percentage of P1-negative individuals among the Chinese did not differ significantly from that for the Malays, it was significantly higher than that for the Indians ($P<0.01$).

Table 1
THE FREQUENCY OF THE P1-NEGATIVE PHENOTYPE, WITH BREAKDOWN ACCORDING TO THE ETHNIC GROUPS.

ETHNIC GROUP	NO. OF BLOOD UNITS SCREENED (ESTIMATES)*	NO. OF UNITS FOUND TO BE P1-NEGATIVE	PROPORTION OF P1 – VE (FREQUENCY)
CHINESE	65.85	53	80.5%
MALAYS	13.71	10	72.9%
INDIANS	12.15	6	48 %
OTHERS	4.29	3	69.9%
TOTAL	96	72	75 %

* Though the actual number of blood units screened (by ethnic distribution) would have been more informative, this information was not routinely documented and was therefore not available; hence the need to use estimates, based on the ethnic distribution prevalent in the donor population.

The weighted average incidence of anti-P1 in the blood-donor population over the period 1982-1986 was calculated to be 9.14 per 100,000 (Table 2). This, then, represents the frequency of this antibody in the healthy adult population of Singapore.

Table 2
INCIDENCE OF THE ANTI-P1 ANTIBODY AMONG BLOOD DONORS FROM 1982 TO 1986.

YEAR	TOTAL DONATIONS (N)	INCIDENCE OF ANTI-P1 (PER 100,000) (I)
1982	59,711	8.28
1983	59,474	7.13
1984	58,018	12.21
1985	59,308	12.0
1986	56,045	6.19
# Weighted Average Incidence =		9.14

Weighted Average Incidence = $(\Sigma Ni)/(\Sigma N)$ per 100,000.

Over the past 6 years, there has been annual anti-P1 pick-up rate of about 137 cases per year (Table 3) among our patient population. Dividing the number of patients found to have anti-P1 in 1987 by the estimated patient pool of 410,000, an average incidence of 13.9 per 100,000 patients was calculated. This figure is only a shade higher than the incidence in the healthy population.

Table 3
THE INCIDENCE OF THE ANTI-P1 ANTIBODY AMONG OUR PATIENTS IN THE PERIOD 1982-1987.

YEAR	NO. OF PATIENTS WITH ANTI-P1
1982	141
1983	121
1984	202
1985	203
1986	99
1987	57
AVERAGE	137.2

Anti-P1 antibodies in our population, as recorded in other studies, have been noted to be limited to P1-negative individuals. The patients in 1987 noted to have these antibodies were further classified according to their race and gender (Table 4).

Although the Malays comprise only about 15% of the population of Singapore, they account for nearly 30% of all patients with anti-P1 antibodies.

Table 4
RACE AND SEX DISTRIBUTION OF PATIENTS WITH ANTI-P1 ANTIBODIES IN 1987.

SEX OF PATIENT	ETHNIC GROUP				
	CHINESE	MALAYS	INDIANS	OTHERS	TOTAL
FEMALE	30	13	1	1	45
MALE	6	4	1	1	12
TOTAL	36	17	2	2	57
% TOTAL	63.16%	29.8%	3.5%	3.5%	

Using the information in Table 1 and Table 4, and the average incidence of the antibody in the healthy adult population, the incidence of the anti-P1 antibody among the 3 ethnic groups was calculated (Table 5).

It should be noted that the Malays have the highest incidence of anti-P1 antibody despite the occurrence of a higher proportion of P1-negatives among the Chinese.

Table 5
THE INCIDENCE OF THE ANTI-P1 ANTIBODY AMONG THE P1-VE AS WELL AS THE GENERAL POPULATION CLASSIFIED ACCORDING TO THE ETHNIC GROUPS.

ETHNIC GROUP	THE INCIDENCE OF ANTI-P1 AMONG HEALTHY PERSONS	
	ALL INDIVIDUALS (per 100,000)	P1-ve INDIVIDUALS (per 100,000)
CHINESE	7.6	9.44
MALAYS	18.28	25.07
INDIANS	3.26	6.79

DISCUSSION

The statistics in Table 1 are comparable to the P1 prevalence frequencies derived for similar ethnic groups in other studies carried out elsewhere (4-6).

It should be noted that the estimation of the frequency of P1 can be difficult owing both to the rarity of potent anti-sera and to the existence of individuals whose red cells only react weakly even with the best available anti-sera.

Anti-P1 is rarely of any clinical importance as it frequently presents as naturally occurring cold agglutinins. Nevertheless a few anti-P1 antibodies have been found active at 37°C and such antibodies are potential causes of hemolytic reactions.

It has been oberved that patients with hydatid disease (7) and Fascioliasis may develop high titres of anti-P1. Microbial stimulation of anti-P1 antibodies has been suggested in many cases of human anti-P1 associated with Donath-Landsteiner antibodies (8-10). Other workers have demonstrated that almost 90% of pregnant P2 women exhibit anti-P1 though no evidence was obtained that this was due to alloimmunization in pregnancy. However, in our study no association was observed between the occurrence of the anti-P1 antibody and the patients' underlying clinical condition.

Over the last decade, successful investigations by independent workers have led to the recognition that the carbohydrate moieties of the glycosphingolipid components of the red cell surface are the specific reactive substances responsible for the blood group specificities (11). Globoside and trihexosyl ceramide that had already been identified previously on human erythrocytes, were recognized as the P and Pk antigens by hemagglutination inhibition studies (12). Monoclonal antisera raised against these specific determinants are expected to pave the way towards a much enhanced understanding of the distribution of these antigens in human tissues.

Two monoclonal antibodies, MC631 (13) and MC813-70 (4), which detect the murine stage-specific antigens, SSEA-3 and SSEA-4, respectively, have recently been shown to agglutinate erythrocytes. Tippett et al. (15) have reported that MC631 recognizes the P antigen. Inglis et al. (16) have developed an IgM anti-P like mouse monoclonal antibody, LM 147/328, raised against an Escherichia coli immunogen. How this series of developments is going to reshape our understanding of the P blood group system remains to be seen.

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