105. A Rare Blood B_x Analogous to A_x in a Japanese Family

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The terminology of ABO variants does not seem to have been fully established. In 1964 we¹⁾ reported three families of a weak B blood designated as B_x. As we pointed out in that paper, it might have been better to adopt notation B_m, if it is preferable to designate that B variant in analogy to weak A. Race and Sanger²⁾ in their "Blood Groups in Man", 5th ed., 1968, mention, "A rare type of B analogous to A_m is known but no convincing example corresponding to A_x has yet been reported."

In the present paper, we deal with a B variant which is quite analogous to A_x found in a Japanese family (Nag., Figure). The propositus (II-7) is a healthy 30-year-old male, a volunteer donor, whose blood showed difficulties in ABO grouping. His other blood systems were:—MNss, P₁, CCDee, kk, Le(a-b+), Fy(a+b-), Jk(a+). The pedigree study has revealed that his father (I-1) and one of his brothers (II-2) also had an atypical blood similar to his.

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Serological Findings. Red cells. The reactions of the three members of the atypical bloods are shown in Table I. The cells of both I-1 and II-2 were agglutinated neither with diagnostic anti-A nor with anti-B sera of human source, but surprisingly showed very good reactions even at 37°C with most of the O-group sera tested (I-1 60/84, II-2 67/84). The agglutination reaction of I-1 and II-2 cells by O-group serum was inhibited not only by B secretor saliva but also by A and O secretor saliva. This non-specific inhibition had not been anticipated, as the reaction of A_x cells by O-group serum had been found to be inhibited specifically by A secretor saliva. It seems very difficult to explain why A_x or B_x cells can be agglutinated by O-group serum and how they are inhibited. The cells of the three members of the present family gave a weak reaction with an animal-immune anti-B serum, suggesting that they might possess a trace of B antigen, while these cells could not be agglutinated by any of the 30 A-group sera selected at random. The presence of the B antigen on these cells was easily confirmed by adsorption-elution test with anti-B human serum. The cells of the three members gave as strong reactions with anti-H lectin as was expected, and the *propositus*' A antigen was of A₁-level.

Table I. Reactions of the red cells

Cells from	Agglutinin			Human anti-		Animal-immune anti-		Lectin*) anti-	
	A	B	A+B	A	B	A	B	A ₁	H
I-1	—	—	+(60/84)**)	—	—	—	+w***)	—	+
II-2	—	—	+(67/84)	—	—	—	+w	—	+
II-7	+	—	not tested	+	+	+	+w	+	+

*) Anti-A₁ was obtained from seed extracts of *Dolichos biflorus* and anti-H from *Ulex europaeus*.

**) A ratio 60/84 indicates that 60 of 84 samples of O-group sera give positive agglutination reactions.

***) +w shows weak reactions.

Table II. ABH substances in saliva

Saliva from	Substances		
	A	B	H
I-1	<1 : 1	<1 : 1	1 : 8
II-2	<1 : 1	<1 : 1	1 : 8
II-7	>1 : 256	<1 : 1	1 : 2
Control			
A ₁ B secretor	>1 : 256	>1 : 256	1 : 1
B _m	<1 : 1	>1 : 256	1 : 8
A _x	<1 : 1	<1 : 1	1 : 4

Serum. The propositus' serum specifically agglutinated all the samples of B- and AB-group cells tested, with the exception of one sample of A_2B_3 cells.^{3),4)} The reactions were inhibited by B secretor saliva, but not by A, O secretor saliva and his own, indicating that this antibody had anti-B specificity. This anti-B was of very low titer even at room temperature and at 5°C, and became inactive at 37°C. I-1 and II-2 also had a weak anti-B similar to that of the propositus, besides the regular anti-A in their sera.

Saliva. The amounts of blood group substances in saliva were expressed as the highest dilution of the saliva which completely inhibited 16 units of anti-A, anti-B and undiluted anti-H (*Ulex europaeus*) (Table II). All the three members of the atypical B blood secreted no B- but H-substance in their saliva, while a B_m saliva examined simultaneously contained as much B-substance as an A_1B saliva did. The saliva of II-2 had normal amount of A-substance as was expected, but the control A_x saliva had no detectable A-substance, but had H-substance.

From the above serological findings that 1. the cells showed negative or weak reaction with anti-B, but good reaction with anti-A+B; 2. the serum contained a weak anti-B; 3. the saliva showed H but no B activity; we have concluded that this weak B in the family may well be designated as B_x in analogy to A_x . Accordingly, the phenotypes of this family members possessing weak B blood may be designated as follows: I-1 B_x , II-2 B_x , II-7 (propositus) A_1B_x .

Pedigree studies. The figure clearly shows that the gene B_x , an allele of B , is transmitted straightforward through the two generations. Since II-4 is of the O-group, the genotypes of I-1 and II-2 may be assumed as B_xO . The A_1 of II-5 and II-7 seems to have been derived from their deceased mother (I-2) whose genotype was probably A_1O . The propositus' father (I-1) positively denied any consanguinity with I-2.

Remarks. Since 1962 we have examined and grouped 713,064 blood specimens by means of both cell- and serum-groupings. In the meantime, we came across 9 families of A_m or A_x including the A_mB or A_xB among the 350,172 samples of A- and AB-group bloods (0.0026%), whereas we found 137 families of B_m or B_x including AB_m or AB_x among the 224,336 samples of B- and AB-group bloods tested (0.061%). As has been pointed out,⁵⁾ it is rather noteworthy that we have found that the frequency of B-variants is much higher than that of A-variants, in spite of that the incidence of B-group is about half that of A-group in Japanese population.

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