Serum Proteins in People of the Yap Islands

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Abstract

Serum protein patterns were studied in 186 female and 147 male adults from the Yap Islands. Total proteins were determined by the Biuret Test and relative amounts of different serum proteins were obtained by scanning electrophoretic patterns. Immunoglobulins A, G, and M were determined in 63 randomly selected samples from this group and Immunoglobulin E from 28 randomly selected samples.

In company with other indigenous populations of the tropical regions of the Pacific, there is an increased mean gamma globulin and decreased albumin in comparison with values from Australian caucasians. A moderately elevated Immunoglobulin G and a marked Immunoglobulin E value was observed in sera from Yap Islands people. The possible reasons for these results are briefly discussed.

Introduction

In 1958, Brading reported total serum protein values and patterns in more than 800 blood samples from inhabitants of the Pacific area, including the New Guinea Highlands, New Guinea coastal areas, Bougainville, Darwin (Australian aborigines), Korea, the Philippine Islands and the British Solomon Islands. She compared these results with those from a sample of Australian caucasian bloods drawn from voluntary blood donors, whose ages ranged from 18 to 80 years. She reported that mean gamma globulin values were elevated and albumins reduced in peoples from tropical areas relative to the Australian bloods. These results were in broad agreement with reports from other regions such as Venezuela (Vera and Roche, 1956), Africa (Mohun, 1946; Holmes, Stainer, and Thompson, 1955) and Fiji (Wills and Bell, 1951). Brading enumerated several possible reasons for these findings, which included patterns of infection, diet or genetic differences.

In 1965 and 1966, one of the authors (J. H. U.) collected blood from 450 adult volunteer inhabitants of the Yap Islands, Micronesia. Blood groups, haptoglobin, transferrin and acid phosphatase genotype frequencies were reported in 1969

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(Hainline, Clark and Walsh). At the same time, protein patterns were studied in unhaemolysed samples from 147 males and 168 females, using the paper electrophoresis and scanning techniques described by Brading (1958). Total serum proteins, γ globulins, α_2 globulins, β globulins and albumins are reported here and compared with values obtained by Brading for White Australians. Immunoglobulins G, A, M, and E (IgG, IgM, IgA, and IgE) were measured in a number of these sera (20 males and 8 females) and compared with values obtained for healthy Australian subjects.

Methods

Blood was collected by venepuncture into B.D. "Vacutainers" without anticoagulant. Volunteers were solicited through the offices of each district magistrate and consisted of ambulatory adults who generously chose to cooperate with the investigating team which set up collection stations at a number of village sites on Yap on specified occasions. Hospital personnel associated with the project excluded any volunteers who were known to be suffering from any blood or serious physical disorder. Blood samples were packed in iced thermos flasks and shipped by air to Australia, via Honolulu, on the day following collection and were re-iced in Guam and Honolulu. Two of the total 450 samples were damaged in transit. After arrival in Sydney, serum was removed from the clotted blood and stored at −20°C until tested. Serum and clots were in contact for a maximum of 72 hours from collection and were kept in ice or in the cold room at all times until separated. Samples which indicated haemolysis were rejected and, in the case of immunoglobulin tests, samples were selected at random.

Of the 440 volunteers for which ages were given, the mean age was 46.10 years; 45.76 percent of the sample was taken from volunteers ranging from seventeen years of age to forty-five years of age (N=205), 52.45 per cent (N=235) of blood samples was taken from volunteers aged 45 years or older, and 8 samples (1.79 percent) were donated by individuals for whom age could not be determined.

Total protein values were obtained by the Biuret method (Robinson and Hogden, 1940), and expressed as grams per 100 ml serum. Paper electrophoresis, staining, clearing and scanning were carried out exactly as described by Brading (1958), using the same equipment. Areas under the curves representing each protein fraction were measured with a planimeter and expressed as percentages of the total area. These percentages were converted to grams per 100 ml by multiplying them by the total protein values obtained by the Biuret method.

Serum IgG, IgA, and IgM levels were assayed using a commercially available radial immunodiffusion method (Tri-Partigen, Behringwerke, A.G.). Serum IgE levels were measured by radio-immunoassay using the commercially available "Phadebas" IgE kit (Pharmacia, Uppsala, Sweden).

Results

Means and standard deviations for total proteins, γ globulins, α_2 globulins, β globulins and albumins are shown in Table 1, where they have been compared with serum values obtained for white Australians by Brading.

"Student's" t test was applied to determine the significance of differences between means for males and females of both groups at the 5 per cent level of significance.

Values for IgG, IgA, IgM and IgE are shown in Table 2.

The findings may be summarized as follows:

1. There is no significant difference between Yap male and female values for total proteins, γ globulins, α_2 globulins, β globulins or albumins.

2. There is no significant difference between total protein values of Yapese and Australian males or females, though mean values are higher in Australian males and lower in Australian females.

Table 1. Serum protein values in White Australians and Yap Islanders

	Value g./100 ml.	S.D.	No.	t value	Significance
Total Protein					
Aust. males	7.24	±0.80	48	1.83	n.s.
Yap. males	7.04	±0.60	147		
Aust. females	6.84	±1.08	64	1.60	n.s.
Yap. females	7.01	±0.57	186		
γ Globulins					
Aust. males	1.89	±0.31	48	5.16	sig.***
Yap. males	2.21	±0.39	147		
Aust. females	1.68	±0.49	64	9.48	sig.***
Yap. females	2.23	±0.37	186		
α_2 Globulins					
Aust. males	0.95	±0.24	48	2.82	sig.**
Yap. males	0.84	±0.23	147		
Aust. females	0.92	±0.24	64	2.67	sig.**
Yap. females	0.84	±0.20	186		
β Globulins					
Aust. males	1.28	±0.27	48	2.82	sig.**
Yap. males	1.16	±0.25	147		
Aust. females	1.17	±0.35	64	1.00	n.s.
Yap. females	1.13	±0.25	186		
Albumin					
Aust. males	3.12	±0.50	48	4.24	sig.***
Yap. males	2.84	±0.36	147		
Aust. females	3.08	±0.61	64	4.67	sig.***
Yap. females	2.80	±0.33	186		

All Australian values are taken from Brading's paper.

Table 2. Immunoglobulin levels in Yap Islanders compared with normal ranges for Australian caucasians.

Immunoglobulin	No.	Mean Value	S.D.	Range	Normal Range
A	63	134 (I.U.)	± 46	55–262	50–270
	63	218 (mg./ml)	± 76	88–433	60–400
M	63	171 (I.U.)	± 49	87–328	50–250
	63	141 (mg./ml.)	± 37	72–261	60–250
G	63	262 (I.U.)	± 73	164–484	80–220
	63	2,340 (mg./ml.)	±653	1,500–4,240	600–1,600
E	28	*4,524 U/ml.	±3,895	850–14,000	10–300

* Ig E values are expressed in arbitrary units, where U~ng. (nanograms)

3. γ globulin values are significantly increased in both Yapese males and females, and albumins are significantly lower in both males and females from the Yap Islands.

4. α_2 globulins are significantly reduced in both male and female Yapese compared with their Australian counterparts.

5. β globulins are not significantly different in females but are reduced in Yapese males.

6. The albumin/globulin ratios of Australians are higher than those for Yapese, Australian males, 0.76; Yapese males, 0.67,
Australian females, 0.82; Yapese females, 0.67.

IMMUNOGLOBULIN LEVELS

Estimation of IgG, IgA, IgM and IgE (in 28 samples selected randomly from the Yapese group) show that, while IgA levels are similar to those found in Caucasians, and IgM levels are only slightly higher than Caucasian levels, both IgG and IgE levels are markedly elevated.

Discussion

The increased γ globulin in sera of both male and female Yapese and the decreased albumin are in agreement with results obtained by Brading for other inhabitants of tropical regions, including the highlands and coastal areas of Papua/New Guinea, Bougainville, and Australian aborigines from Darwin in Northern Australia.

Values for α_2 globulin were also reduced in both males and females. One possible reason may be a reduced amount of haptoglobin. Hainline, Clark and Walsh (1969) report three Yapese sera with no detectable haptoglobin after electrophoresis. Booth and Vines (1968) associated low haptoglobin values with the presence of chronic malaria, but malaria has never been reported in the Yap Islands. Other possible reasons for decreased α_2 globulins are the presence of repeated and

chronic infections, including malaria, protein malnutrition and/or a predominantly vegetable diet (Brading, 1958). All these factors, with the exception of malaria, probably apply to the inhabitants of Yap Islands.

Estimations of the individual immunoglobulin levels show a marginal increase in IgM and a marked elevation of IgG and IgE in Yap Islanders. These results are in agreement with other reports of immunoglobulin levels in tropical populations (Turner and Voller, 1966; Rowe *et al.*, 1968; Johansson, Mellbin, and Vahlquist, 1968; Crane *et al.*, 1971). While racial or genetic influences may play a part (Endozien, 1961; Rowe *et al.*, 1968; Shaper *et al.*, 1968), there seems little doubt that the major stimulus to increased immunoglobulin production is the exposure to repeated parasitic infections.

Increased IgE levels have been reported in patients suffering from allergic diseases such as extrinsic asthma, hay fever, and atopic eczema. Markedly elevated levels have also been reported in parasitic diseases due to a wide variety of worm infestations (Johansson *et al.*, 1972). The elevated IgE levels found in the Yapese sera may be due to repeated parasitic infections.

The immunoglobulin results found in this study provide further support to the theory that environment plays the major role in increased immunoglobulin production by peoples in tropical regions. Hainline has pointed out that the ancestral origins of the people of the Yap Islands are obscure, but that the population dwindled from a possible maximum of 40,000 prior to the time of intensive contact (about 1850) to ca. 2,500 in 1947. They are in a phase of rapid expansion and probably form a separated genetic pool from those of other Pacific peoples, yet they show similarities with other groups indigenous to tropical areas, particularly of the Pacific region.

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