VARIATIONS IN THE LEVEL OF HUMAN SERUM ALBUMIN DURING GLUCOSE TOLERANCE TEST.

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SUMMARY

The serum protein level in patients taking the glucose tolerance test was found to vary. This variation was accounted for by changes in the level of serum albumin which dropped an average of 17% one hour after the administration of glucose. The serum albumin level returned to its normal value when blood glucose and non-esterified fatty acid levels returned to their initial levels. It is suggested that this variation is the result of a shift of albumin between the intravascular and extravascular compartments.

The concentration of human serum albumin is the resultant of many factors such as: synthesis, degradation, distribution and blood volume. Nevertheless the level of this protein in the serum of healthy subjects remains virtually unchanged[1-5]. The constancy of the level of this serum protein in health makes its measurement a reliable index in the diagnosis of a variety of diseases[6].

In a study on the serum proteins of subjects undergoing the glucose tolerance test we noticed some variation in the level of the total serum proteins during the test. In the work presented here we study the levels of total serum proteins, serum albumin and serum globulins in healthy adults undergoing the glucose tolerance test.

PATIENTS AND METHODS

15 healthy men ranging in age between 28 and 40 years were fasted overnight, a fasting blood sample was obtained

before each patient received 1 gm of glucose/kg body weight orally. Three more blood samples were obtained 30 min. 60 min. and 120 min. after the administration of glucose. On each serum sample obtained the glucose level was measured on the Technicon Autoanalyser[7]. The level of nonesterified fatty acids was measured using the method of Dole and Meinertz[8] and the results expressed as microequivalents of fatty acids per liter of serum. Total serum proteins were measured by the micro Kjeldahl method[9] after the precipitation of the proteins with sodium molybdate to remove the non-protein nitrogenous compounds. Electrophoresis of serum was done on cellulose acetate membranes using Beckman microzone cell model R-101 and the relative proportions of albumin, alpha, beta and gamma globulins were determined by scanning the Ponceau-S stained cellulose acetate membrane on Beckman Analytrol. From the total serum protein value and the relative proportions of the electrophoretic bands, the levels of albumin, alpha, beta and gamma globulins were calculated.

RESULTS AND DISCUSSION

The results of the determination of the levels of glucose nonesterified fatty acids, albumin and globulins on each serum sample obtained are given in Table I. Since there was almost no change in the level of the individual globulins, the results of the globulin levels are expressed as total globulin concentration.

Statistical analysis of the variations in the albumin level using Duncan's multiple range test[10] shows that there were significant differences between the fasting albumin level and the levels at 30 min and 1 hr ($p < 0.001$). Using the same test there were no significant differences between the values at any time during the GTT for the individual globulin bonds or for the total globulin level ($p > 0.5$).

The drop in the level of total serum proteins following the administration of glucose could either be due to serum proteins leaving the circulation or to an increase in the amount

Table I variation in the levels of glucose, nonesterified fatty acids, serum albumin and total serum globulin in 15 adult males undergoing the glucose tolerance test.

No.	Glucose mg%				Fatty Acids μeq/l				Albumin gm%				Total Globulin gm%			
	0	30min	1hr	2hr	0	30min	1hr	2hr	0	30min	1hr	2hr	0	30min	1hr	2hr
1	104	128	140	100	916	702	580	870	3.1	2.9	2.9	3.2	4.8	4.5	4.5	4.4
2	95	140	185	113	956	827	655	887	2.8	2.5	2.4	2.4	4.2	4.4	4.0	4.4
3	82	120	92	85	815	410	530	650	3.4	2.9	2.9	3.0	4.5	4.3	4.5	4.5
4	90	145	140	120	730	580	330	380	3.5	2.7	3.1	3.4	4.1	4.1	4.0	4.1
5	94	162	133	95	999	520	615	629	3.3	3.1	2.9	3.1	3.7	3.7	3.7	3.8
6	76	189	170	70	750	520	583	650	3.9	3.1	3.3	3.3	3.9	3.9	3.9	4.2
7	90	98	160	93	841	784	373	556	3.9	3.1	3.1	3.3	3.9	4.0	4.2	4.2
8	86	156	172	72	870	680	428	547	3.8	3.0	2.8	3.5	3.9	3.7	3.9	3.9
9	90	118	125	80	998	689	687	895	3.1	3.0	3.0	3.0	4.5	4.4	4.4	4.5
10	95	120	155	90	887	550	437	710	3.1	2.9	2.6	3.1	4.4	3.9	4.2	3.9
11	80	127	150	122	888	851	740	800	3.5	3.2	2.7	3.5	3.7	3.6	3.7	3.6
12	73	90	168	92	900	468	359	619	3.4	2.8	2.6	3.4	4.5	4.1	3.7	4.3
13	70	85	165	90	902	465	360	620	3.1	2.6	2.2	3.1	4.1	4.2	4.5	4.4
14	76	93	171	94	898	471	358	618	3.1	2.5	2.4	2.9	4.5	4.4	4.2	4.1
15	74	89	169	94	907	468	360	619	3.5	2.5	2.5	3.1	4.3	4.5	4.4	4.5
Mean	85	124	153	94	884	599	493	670	3.4	2.9	2.8	3.2	4.2	4.1	4.1	4.2
±S.D	10	31	24	15	133	146	141	142	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3

of water in the circulation. Since most of the drop in the level of serum proteins could be accounted for by the fall in the level of albumin, this drop could not have been due to the dilution of the blood with water, but was probably due to serum albumin leaving the blood circulation. An increase in the intravascular water should have caused a drop in the globulin level proportional to that of albumin.

Using our data together with other information about the volume of the extravascular space it is possible to calculate the change in osmotic pressure between the intravascular and extravascular compartments that could result from variations in the level of serum albumin during a glucose tolerance test. The mean drop in the level of serum albumin 60 min. after the administration of glucose was 0.6 gm% which is about 17% of the mean fasting serum albumin. If we consider the volume of the extravascular fluid to be about three times that of the intravascular[11] then a drop of 0.6 gm% in the level of serum albumin should increase the extravascular albumin concentration by 0.2 gm% if we assume that this amount of albumin is evenly distributed in the extravascular space. The drop in the level of serum albumin and the increase in the extravascular albumin level should decrease the albumin concentration gradient (intravascular minus extravascular) of albumin by 0.8 gm%. Since each gm% of albumin exerts an osmotic pressure of 5.54 mm. Hg[12], then this drop of albumin will change the osmotic pressure gradient between the intravascular and the extravascular compartments by about 4.4 mm. Hg (0.8 x 5.54). This is a significant fraction of the 25 mm. Hg osmotic pressure due to the blood proteins[12].

The clinical implications of the fall of albumin during the glucose tolerance test are important. In cases where albumin is on the low side but not low enough to produce oedema, then the rapid administration of large quantities of glucose might lower the level of serum albumin even further and result in oedema. This observation could also help in understanding the factors which control the circulation of albumin between the intravascular and extravascular compartments.

The mechanism of this phenomenon is not clear yet. It could

be associated either with the drop in the level of nonesterified fatty acids or the rise of the glucose level or both. As a result of glucose loading and the consequent fall in the rate of fat mobilization, it is quite possible that albumin, which is a carrier for fatty acids, may leave the circulation at a rate faster than that at which it returns.

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