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Effect of Insulin on Serum Proteins in Scurvy.* (26239)

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It has been reported(1) that in scorbutic guinea pigs a_2 and β_2 globulins are diminished; a_1-globulin is increased and no change takes place in β_1 and γ-globulins. Insulin is involved in biosynthesis of proteins (2) and hypoinsulinism has been observed in scurvy (3,4). The derangement of serum proteins in scorbutic guinea pigs might have been due to diminished insulin formation. It was, therefore, of interest to study the effect of prolonged injection of small doses of insulin on the protein pattern of serum in guinea pigs during the progress of scurvy. The carbohydrate and lipid containing proteins of normal, scorbutic and insulin-treated scorbutic guinea pigs were also determined.

Methods. Forty-eight male guinea pigs each weighing between 250 and 300 g were divided into groups of 3 animals, one normal, one scorbutic and one insulin-treated scorbutic. All the animals were fed a scorbutogenic diet(5). The amount of diet consumed per day by the scorbutic member of a group was fed to the other 2 members of the group on the subsequent day. The 'normal' animals were fed 5 mg ascorbic acid per animal per day. All the animals received 2 drops of a concentrate of Vit. A and D twice a week. From the 10th day on each animal of the insulin treated group was given a daily subcutaneous injection of protamine zinc insulin (Lilly) in a dose increasing from 0.1 unit per 100 g body weight to 0.3 unit over the period of experiment. On the 24th day of experiment all the animals were sacrificed after an over-night fast, blood collected from neck veins, and clear serum analyzed for different protein fractions(6), glyco- and mucoproteins (7) and lipoproteins(8,9). Swahn(10) had shown that uptake of Sudan Black B by whole serum on filter paper was correlated with total lipid content of serum. Total area of the plotted curve was, therefore, equivalent to total serum lipid content of sample used for electrophoresis. The a and β-lipoproteins and the "o" fraction were expressed, on the basis of their respective areas, as percentages of the total area and hence of total lipid.

Results. Serum albumin and a_2 and β_2 globulins which diminished and a_1 globulin which increased in scurvy were brought back to approximately normal level after prolonged insulin treatment of the scorbutic animal. Serum glycoprotein and mucoprotein fractions which increased in scurvy remained unaffected after insulin treatment. Serum a-lipoprotein and "o" fractions considerably diminished and β-lipoprotein fraction significantly increased in the scorbutic condition. Insulin treatment did not produce marked effect on these fractions. The results are given in Table I.

Discussion. The alterations in serum protein patterns of scorbutic guinea pigs could

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TABLE I. Different Fractions of Serum Proteins in Guinea Pigs.*

	Normal	Scorbutic	Insulin-treated scorbutic
Albumin (% of total protein)	49.07 ± .48	42.38 ± .57	44.70 ± .86
Globulins—α_1	8.15 ± .11	14.78 ± .23	8.14 ± 1.69
α_2	26.10 ± .38	21.58 ± .32	25.68 ± .18
β_1	4.25 ± .05	4.26 ± .07	4.33 ± .07
β_2	6.85 ± .09	5.37 ± .22	6.85 ± .06
γ	5.68 ± .52	11.67 ± .69	10.35 ± 1.17
Total serum proteins (%)	5.43 ± .16	3.45 ± .23	4.17 ± .13
Glycoproteins (mg hexose/100 ml)	156 ± 4.03	194 ± 8.66	188 ± 5.02
Mucoproteins (*idem*)	24 ± 1.17	45 ± 1.67	55 ± 2.42
Lipoproteins (%)—α-fraction	36.8 ± .85	17.65 ± .33	18.17 ± .55
β "	26.5 ± .85	65.70 ± .96	54.24 ± 2.89
"o" "	36.6 ± 1.01	17.09 ± .95	28.63 ± .58

* Sixteen animals in each group. Values are mean ± S.E.

be brought back to almost normal levels after insulin treatment of the scorbutic guinea pigs for 14 days. The changes in the protein pattern in scurvy, therefore, might be due to insulin insufficiency associated with the condition. The increase in serum glyco- and mucoproteins of scorbutic guinea pigs might be due to an increased release of mucopolysaccharides from ground substances. In scurvy, serum α-lipoprotein is diminished whereas total of serum α_1- and α_2-globulins is not altered. The significant increase in β-lipoproteins with no change in total β-globulins in scurvy is possibly due to increased body serum cholesterol observed in this condition(11).

Summary. Serum albumin, α_2- and β_2-globulins which diminished and α_1-globulin which increased in scurvy became approximately normal after insulin treatment. The changes in protein pattern of serum might be due to insulin deficiency of scorbutic guinea pigs. Serum glycoproteins, mucoproteins and β-lipoproteins increased and α-lipoprotein and "o" fraction diminished in scurvy. Insulin treatment did not produce marked change in these fractions. Vit. C seems to have a specific role in metabolism of mucopolysaccharides.

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