Effect of D-Sorbitol on the Absorption and Transfer of Nutrients from Mother to Fetus

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IT IS well recognized that during pregnancy a woman is under physiologic stress and that her nutritional needs are markedly increased. Although there is a physiologic adjustment which increases her ability to absorb the nutrients required for the development of the fetus, her own optimum nutritional levels must be maintained.

Since the fetus is "parasitic" on the mother's store of nutrients, particularly vitamins B_{12}, B_6 and C and iron, a substance which would enhance the mother's ability to absorb these nutrients would be of therapeutic value. Chow and co-workers have shown that the administration of D-sorbitol can significantly increase the absorption of oral doses of vitamin B_{12} given to pregnant women.[1] We undertook this work to study further the effect of D-sorbitol on the absorption of four nutrients—vitamins B_{12}, B_6, C and iron—through the analysis of maternal and fetal blood specimens.

MATERIALS AND METHODS

Two liquid preparations, one with D-sorbitol and the other without, were used in this study. Each 5 cc. of the two preparations contained the following: vitamin B_{12} (crystalline) 8.34 μg., vitamin B_6 (pyridoxine hydrochloride) 2.0 mg., ferric pyrophosphate 100.0 mg., folic acid 0.5 mg. With each preparation, a 100 mg. tablet of ascorbic acid was also given.

Pregnant women a few hours away from delivery, who had been admitted to the charity ward of the Philippine General Hospital, were selected as the subjects. At the time of admission, 20 cc. of blood designated as specimen B (before), was obtained from the patient by means of venipuncture. The patient then was given orally 30 cc. of one of the liquid preparations and a 100 mg. tablet of ascorbic acid. The preparations, one wth D-sorbitol and the other without, were given to alternate patients. Immediately after delivery, 20 cc. of blood, designated specimen A (after), was extracted from all the patients. As much blood as possible was extracted from the cord of the fetus and designated as specimen F (fetus).

The same procedure was followed with a second group of pregnant women, except that a double dose of the nutrients (60 cc. of the preparations and two tablets of ascorbic acid) was given. A third group of pregnant women was given a placebo preparation of plain syrup. As with the other two groups, blood samples were obtained before and after the preparation was given.

The blood serum from the three groups of women was analyzed for vitamin B_{12}, vitamin C, transaminase (a measure of vitamin B_6) and iron content. Vitamin B_{12} content was determined by the microbiological assay method,[2] transaminase by the SGOT procedure,[3] vitamin C by titration with Tillmans' reagent,[4] and iron by Barkan's method.[5]

RESULTS

The serum analyses are summarized in Tables I through IV. The mean value for specimens B, A and F are indicated along with the mean difference between A and B by specimen (A–B), and F and A by specimen (F–A). (A–B) serves as a measure of maternal absorption and (F–A) as fetal absorption at the time of delivery. The standard errors for (A–B) and (F–A) are also included for the statistical analysis of data.

Vitamin B_{12}

It may be seen in Table I that in all the groups studied the vitamin B_{12} level in the fetus was always higher than that in the mother. This was also true in the group

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TABLE I

Levels of Vitamin B_{12} (μg. per ml.) in Pregnant Women Given Preparations of Vitamins and Iron

Specimen	With D-Sorbitol			Without D-Sorbitol			With Plain Syrup		
	No. of Subjects	Mean	S.E.*	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.
Single Dose									
B	14	0.174	...	14	0.161	...	13	0.116	...
A	14	0.216	...	16	0.188	...	13	0.120	...
F	12	0.450	...	15	0.499	...	13	0.380	...
A–B	14	0.055	0.021	16	0.016	0.018	13	0.026	0.026
F–A	12	0.172	0.041	15	0.330	0.077	13	0.211	0.094
Double Dose									
B	16	0.194	...	14	0.172	...			
A	16	0.286	...	14	0.283	...			
F	6	0.571	...	7	0.627	...			
A–B	16	0.106	0.016	14	0.093	0.035			
F–A	6	0.310	0.064	7	0.327	0.026			

* Standard error.

TABLE II

Levels of Vitamin C (mg. per 100 ml.) in Pregnant Women Given Preparations of Vitamins and Iron

Specimen	With D-Sorbitol			Without D-Sorbitol			With Plain Syrup		
	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.
Single Dose									
B	19	0.68	...	20	0.76	...	13	0.90	...
A	19	0.89	...	20	0.99	...	13	0.82	...
F	19	1.46	...	20	1.53	...	13	1.39	...
A–B	19	0.20	0.07	20	0.23	0.07	13	−0.08	0.03
F–A	19	0.57	0.01	20	0.54	0.10	13	0.57	0.12
Double Dose									
B	16	0.91	...	18	0.78	...			
A	16	1.28	...	18	1.18	...			
F	16	1.88	...	18	1.91	...			
A–B	16	0.36	0.10	18	0.43	0.08			
F–A	16	0.60	0.12	18	0.79	0.14			

given the placebo preparation, although it was not as high as in the other two groups. In the patients given the single dose, the increase in the absorption level in the mother (specimen A–B) was statistically significant in those who received D-sorbitol and statistically insignificant in those who did not. In those given the double dose, the increase in the vitamin B_{12} level in the mother was statistically significant in both groups. That is, sorbitol

TABLE III
Levels of Transaminase (units per ml.) in Pregnant Women Given Preparations of Vitamins and Iron

Specimen	With D-Sorbitol			Without D-Sorbitol			With Plain Syrup		
	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.
Single Dose									
B	18	18.1	...	17	18.8	...	13	25.4	...
A	16	21.8	...	17	20.6	...	13	28.1	...
F	15	41.0	...	15	39.0	...	13	44.5	...
A–B	16	3.7	1.8	17	1.8	1.5	13	2.7	2.1
F–A	14	13.6	4.6	15	19.3	1.8	13	16.4	4.8
Double Dose									
B	17	20.4	...	18	20.7	...			
A	18	25.3	...	18	26.4	...			
F	16	43.6	...	17	49.9	...			
A–B	17	5.0	2.4	18	5.9	2.0			
F–A	16	18.4	2.6	17	23.3	2.7			

TABLE IV
Levels of Iron (μg. per 100 ml.) in Pregnant Women Given Preparations of Vitamins and Iron

Specimen	With D-Sorbitol			Without D-Sorbitol			With Plain Syrup		
	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.	No. of Subjects	Mean	S.E.
Single Dose									
B	14	69.0	...	13	101.0	...	13	33.5	...
A	14	140.4	...	14	132.4	...	13	41	...
F	10	224.0	...	12	181.2	...	11	111.5	...
A–B	14	71.0	18.9	13	36.2	20.5	13	5.9	4.5
F–A	10	89.8	28.5	12	53.0	18.2	11	66	9.2
Double Dose									
B	16	67.6	...	16	63.4	...			
A	14	161.5	...	17	136.0	...			
F	14	177.3	...	10	173.1	...			
A–B	13	76.0	20.0	16	68.8	19.1			
F–A	11	10.7	21.1	11	38.4	14.5			

did not enhance vitamin B_{12} absorption when the larger doses were given. There was no significant difference between the A and B specimens in the group given the placebo preparation.

Vitamin C

It may be seen in Table II that the vitamin C level was higher in the fetal blood than in the maternal blood in all three groups. However, the increase in the vitamin C level in

maternal blood was significant in all the groups given the preparations whether D-sorbitol was included or not. On the other hand, in the group receiving the placebo, there was a slight decrease (0.90 to 0.82) in the vitamin C level of the maternal blood. The F–A level of vitamin C in the group which received the placebo and the two groups which received the nutrients with and without D-sorbitol was essentially the same.

Transaminase B_6

As indicated in Table III, the transaminase levels in fetal blood were approximately twice as high as those in the maternal blood, both before and after delivery. In the maternal blood, the levels rose slightly after delivery. The administration of D-sorbitol did not influence the transaminase levels of either the maternal or the fetal blood. There was no marked difference in the group given the placebo either.

Iron

Interpretation of the findings in Table IV is difficult in that the level before administration (B) of various preparations varied from a mean of 33 to 101 μg. per ml. In general, iron levels increased with administration of iron, and absorption seemed to be enhanced by the administration of D-sorbitol.

SUMMARY AND CONCLUSIONS

The results of this study show that the levels of nutrients in maternal and fetal blood were increased by supplements taken orally by the mother just prior to delivery when measured before and immediately after delivery. The levels of vitamin B_{12}, vitamin C, pyridoxine and iron were higher in fetal than in maternal blood.

The results also show that the administration of D-sorbitol may enhance vitamin B_{12} absorption by the mother but not of the other nutrients. However, the absorption of vitamin B_{12} under these conditions was not great enough to be of clinical importance.

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