650 SERUM COPPER AND CERULOPLASMIN IN THE PREMATURE INFANT.

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Serial serum copper (Cu) and ceruloplasmin (Cerlp) concentrations were followed for an average of 14 weeks in 25 well, growing AGA premature infants (mean GA=30 wks., mean B.W.=1181gms.) fed standard infant formulas.

	Cu ($\bar{x}$) µg/dl	Cerlp ($\bar{x}$) mg/dl	Cerlp/Cu mg/dl
0-72 hrs.	25	4.9	.17
Week 1	32	8.8	.25
4	32	9.2	.26
8	42	14.1	.34
9-12	48	15.0	.31
13-16	66	18.2	.28
17+	79	23.6	.28

Serum Cu and Cerlp, low at birth, gradually increased over the first 5 months of life. No relationship between Cu intake (µg/kg) and serum Cu concentrations was seen as serum Cu was lowest when intake was highest. The ratio of Cerlp/Cu was constant ($\bar{x}$=.28) except for the first 72hrs. of life when the ratio was significantly lower (p=.00007). The data suggests: 1. serum Cu is controlled by factors other than dietary intake; 2. Cerlp production relative to serum Cu increases significantly over the first week of life; 3. Changes in serum Cu are paralleled by proportional changes in Cerlp after the first 72 hrs. of life.

651 GROWTH & DEVELOPMENT OF INFANTS < 1500 g FED BANKED HUMAN MILK (BHM) OR PREMATURE FORMULA (F).

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BHM composition and nutritional adequacy for infants < 1500g has not been established. We have randomized 65 infants < 1500g to ad lib feeds of F (Similac Special Care, a protein and mineral enriched formula designed to sustain intrauterine-like growth) or frozen BHM until infants weighed 2000g. BHM was low in fat (2.3%) and calories (bomb analysis 58 cal/100g), a finding also recently noted by Carroll. BHM infants ingested more milk (192 vs 162 ml/kg/d) but fewer calories (121 vs 142 cal/kg/d); grew less in weight (14 vs 30 g/d), length (0.7 vs 1.1 cm/wk), and FOC (0.8 vs 1.2 cm/wk); and at 37 wks post-conception were less responsive to visual & auditory stimuli (Brazelton orientation items, mean score = 2.4 vs 3.6; p < 0.05). Amino acids, BUN, and pH values were similar. Findings at blind evaluation 92 wks post-conception:

	Weight	Wt.Delay*	Length	Lgth.Delay*	FOC	FOC Delay*
BHM(9)	8206g	3.8 mo	71.3cm	2.6 mo	45.1cm	1.6cm
F(20)	9386g	0.0 mo	73.8cm	0.6 mo	45.6cm	0.0 mo
p	<0.05	<0.025	<0.025	<0.025	NS	NS

Bayley developmental scores were higher for F than BHM infants at 92 wks (PDI:92 vs 78; p<0.05; MDI:89 vs 76, p=0.13). Birthweight, gest. age, and need for ventilation were similar for BHM and F infants seen at 92 wks. F supports near intrauterine growth rates and may confer short and long term advantages over BHM for infants < 1500g.

*Actual age minus age at which measurements equal 50th percentile.

652 INTESTINAL TRANSPORT AND LIVER UPTAKE OF A FOOD ADDITIVE PRESENT IN INFANT FORMULAS.

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Undegraded carrageenan, a sulfated polygalactan macromolecule, is used as an emulsifier in ready-to-use infant formulas. Although undegraded carrageenan has not been shown to be transported across the intestine the safety of this food additive has recently been questioned because of its toxic effect on the intestine and liver of laboratory animals (Lancet 1:602, 1980). We have shown that intestinal macromolecular transport is increased early in life, therefore, newborns may be more susceptible to any toxic effect of carrageenan. To investigate the intestinal transport and toxicity of carrageenan in newborn animals, 40 mgm of carrageenan, a quantity present in 5 oz of formula, was given by gavage to newborn rabbits. Cardiac and portal blood were obtained four hours later. The stomach, small intestine and liver of animals were removed and homogenized. Double gel-diffusion with antiserum raised to λ-carrageenan was used to detect the presence of carrageenan in blood and tissue specimens. The results are expressed in animals positive for carrageenan/animals tested.

CARDIAC BLOOD	PORTAL BLOOD	STOMACH	SMALL INTESTINE	LIVER
0/13	0/13	12/12	7/12	7/12

This data suggests that undegraded carrageenan is transported across the intestine and is cleared by the liver. Morphologic studies of the developing intestine and liver are currently in progress to determine the degree of carrageenan toxicity.

653 FOOD PROTEIN-INDUCED ENTEROCOLITIS: CORRELATION BETWEEN ORAL CHALLENGE AND LYMPHOCYTE TRANSFORMATION INDUCED BY SPECIFIC FOOD PROTEINS.

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Previous studies correlating lymphocyte blast transformation and various in vivo manifestations of food protein intolerance have produced conflicting results. We compared the incorporation of H^3 thymidine into lymphocytes cultured with each of 3 food protein antigens (cow-milk, soy, egg) with the response to acute oral challenge in a group of infants (<1 year old) with a history of enterocolitis. Challenges were performed and evaluated as previously described (J. Ped. 93:533) at least 1 month after recovery from enterocolitis. In 6 infants with negative responses to all three oral challenges, the mean stimulation index

$$(SI) = \frac{\text{(dpm lymphocytes with antigen)}}{\text{(dpm lymphocytes without antigen)}}$$

was 1.4 ± 0.5 (S.D.) with no difference between antigens. The mean SI for 3 patients with positive oral challenges to soy was 13.7 and for 6 patients with positive oral challenges to cow milk, 6.1. Both values were significantly higher than the respective SI's in the negative oral challenge group (p<.02). The magnitude of the in vitro response correlated with the antigens responsible for positive oral challenges. These data suggest that infants with a well defined food protein-induced enterocolitis have blood lymphocytes sensitized to the specific antigens. A pathogenic role for these lymphocytes remains to be demonstrated.

● 654 EFFECT OF PERORAL ADMINISTRATION OF ACTH ON PLASMA CORTICOSTERONE LEVELS IN SUCKLING RATS: TIME AND DOSE DEPENDENCY.

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The presence of ACTH in rats' milk prompted us to explore whether ACTH given perorally (p.o.) to suckling rats has an effect on plasma corticosterone (C). After this was demonstrated in preliminary experiments, we studied the time dependency of the ACTH effect. In suckling Sprague-Dawley rats (11-14 days old), starved for 2 hours and then fed $ACTH_{1-39}$ (Armour, 0.50 U/g BW in water), plasma C peaked at 30 minutes and remained significantly higher until 180' when compared with water-fed controls.

Plasma C Levels (mean ± SEM, N/group: 5-24)

Time	Control	30'	60'	120'	150'	180'
C (µg/dl)	2.3±.3	6.8±.9	6.2±.8	5.7±.6	4.2±.4	1.6±.1
p-value		<0.001	<0.001	<0.001	<0.001	NS

To determine the lowest effective dose, varying amounts of ACTH were given p.o. (0.06; 0.13; 0.25; 0.50 and 1.00 U/g BW) and plasma C measured 2 hours later. The two lower doses evoked an insignificant change; a significant increase was seen using the 0.25 U dose. Its effect was the same as that of the higher doses used.

These studies thus demonstrate the acute effect of p.o. ACTH in suckling rats. Further studies are needed to evaluate the physiologic role of ACTH normally present in rats' milk.

655 ACHIEVEMENT OF HIGH CA AND P CONCENTRATIONS IN PARENTERAL NUTRITION SOLUTIONS FOR NEONATES

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Supply of nutrients approximating intrauterine accretion rates is a goal for total parenteral nutrition. In prematures it has been difficult to achieve high levels of Ca and P in parenteral nutrition solutions because of incompatibility of these minerals. We determined the amounts of these ions held in stable solution in Dextrose 5 or 10% and Amino acid 1.25% or 2.5% solution containing Zn, Cu, Mg, multivitamins, folic acid, Vit. K and Vit. B_{12}. The appearance of the solutions was noted immediately and after 24 and 48 hrs at 4°C. When 10% Ca gluconate (9.4mgCa/ml) was added first to the base solution followed by K phosphate (P 93 mg/ml) precipitates occurred on addition of 1-2 drops of K phosphate. When P was diluted and then added, larger amounts of Ca and P were held in stable solution. However when the order of addition was reversed, i.e., P added first followed by Ca, optimal amounts of Ca and P were held in stable solution. The solubility of Ca and P in D 10% AA 2.5% was greater than in D 5% AA 1.25%, and at least 25% more P could be added. With D 5% AA 1.25% no precipitates were observed at 4°C in 48 hrs at Ca 150 mg/dl with P ≤50 mgm/ dl; at Ca 100 mg/dl with P ≤75mgm/dl, at Ca 50 mgm/dl with P ≤ 100 mgm/dl. With D 10% AA 2.5% no precipitates occurred at 4°C in 48 hours at Ca 150 mg/dl with P ≤100 mgm/dl; at Ca 100mgm/dl with P 100 ≤mgm/dl; at Ca 50 mgm/dl with P ≤125 mgm/ dl. Thus, when the order of addition of P and Ca in D-AA solutions is optimal it is possible to achieve high levels of these minerals exceeding that needed to approximate intrauterine requirements.