INFANTS WITH MATERNAL TOXAEMIA

GLUCAGON TOLERANCE TESTS

Toxaemia of pregnancy is considered to be an important cause of placental insufficiency and is often associated with the birth of 'Small-for-date' infants (Cornblath et al., 1964). Incidences of hypoglycaemia in the infants of toxaemic mothers have been demonstrated by Cornblath, Odell and Levin (1959); Brown and Wallis (1963); Neligan et al. (1963); Chance and Bower (1966) and Laron, Mannheimer, Nitzan and Goldmann (1967). Hepatic glucose output after administration of glucagon is studied in ten infants with maternal toxaemia both on the first (within two to three hours after birth) and eighth days of life.

RESULTS:

1. Full-term infants with maternal toxaemia:

The results of the mean plasma glucose, inorganic phosphorus, potassium, urea and total amino acid nitrogen (TAN) concentrations before and after glucagon administration on the first and eighth days have been summarised in Tables 38 and 39 respectively. Net increases in the plasma glucose concentrations for these two days are shown in Table 40. Fig. 12a illustrates the behaviour of the above mentioned parameters, while 13a represents the changes in the plasma glucose concentrations on both these days.

2. Premature infants with maternal toxaemia:

The results of the mean concentrations of plasma glucose, inorganic phosphorus, potassium, urea and TAN, preceding and following glucagon administration in the three premature infants

with maternal toxaemia on the first and eighth days are shown in Tables 41 and 42 respectively. Table 43 represents the net increases in the plasma glucose concentrations. Fig. 14a demonstrates behaviour of the above mentioned parameters while Fig. 15a denotes the changes in the plasma glucose levels on both these days.

Representative data as regards the behaviour of the changes in the plasma glucose and other similar parameters after glucagon administration in non-symptomatic infants with maternal toxaemia are not available from the literature.

DISCUSSION:

The infants having maternal toxaemia are relatively more hypoxic at birth than the corresponding non-toxaemic group. This increased severity of hypoxia occurs due to the placental insufficiency (Holman and Lipsitz, 1966) and may lead to a more stressful birth. As mentioned previously the more stressful birth would result in a somewhat quicker and better hyperglycaemic response seen on the first day of life after glucagon administration.

A somewhat enhanced hyperglycaemic response after glucagon seen on the eighth day of life may be on account of an increase in the neoglucogenetic activity.

TABLE 38.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS, POTASSIUM, UREA AND TOTAL AMINO ACID NITROGEN CONCENTRATIONS (MEAN) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST DAY (within 2 to 3 hours)OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucagon administration					
		20	40	60	90	120	150
Glucose (mg./100 ml.)							
Mean	42.2	72.8	96.8	104.8	94.4	81.0	62.2
Range	23-62	38_114	65-127	69-149	61-128	55-126	34-95
No.	5	5	5	5	5	5	5
Inorganic phosphorus (mg./100 ml.)							
Mean	5.96	5.74	5.58	5.64	5.46	5.32	4.92
Range	5.0-6.9	4.8-6.4	4.9-6.1	4.8-6.4	4.7-5.9	4.3-5.8	4.3-5.2
No.	5	5	5	5	5	5	5
Potassium (mEq/L.)							
Mean	5.54	5.28	5.02	5.06	5.00	4.98	5.16
Range	4.6-6.9	4.4-6.1	4.1-6.1	4.1-6.4	3.9-6.4	3.8-6.0	4.0-6.5
No.	5	5	5	5	5	5	5
Urea (mg./100 ml.)							
Mean	27.4	30.8	31.4	32.2	34.0	33.6	34.6
Range	16-43	17-47	20-45	17-45	20-46	19-47	22-47
No.	5	5	5	5	5	5	5
Total amino acid nitrogen (mg./100 ml.)							
Mean	4.66	3.34	3.76	3.50	3.34	2.74	2.08
Range	4.0-5.6	2.4-4.1	3.0-4.4	2.4-4.5	2.2-4.5	1.4-3.9	1.6-2.6
No.	5	5	5	5	5	5	5

TABLE 39.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS, POTASSIUM, UREA AND TOTAL AMINO ACID NITROGEN CONCENTRATIONS (MEAN) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE EIGHTH DAY OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucagon administration					
		20	40	60	90	120	150
Glucose (mg./100 ml.)							
Mean	71.2	114.7	124.2	126.5	117.2	100.2	83.5
Range	48-106	92-154	83-162	63-176	42-162	47-138	48-107
No.	4	4	4	4	4	4	4
Inorganic phosphorus (mg./100 ml.)							
Mean	5.95	5.54	5.22	5.27	5.42	5.45	5.57
Range	4.1-7.7	3.4-7.7	2.8-7.3	3.5-7.0	3.7-7.5	3.8-7.0	3.9-7.0
No.	4	4	4	4	4	4	4
Potassium (mEq/L.)							
Mean	4.10	3.47	3.17	3.50	3.47	3.47	3.83
Range	3.5-5.0	3.3-3.8	2.9-3.6	2.9-4.1	2.7-4.4	2.9-4.4	3.0-4.6
No.	4	4	4	4	4	4	4
Urea (mg./100 ml.)							
Mean	19.2	20.7	23.5	25.0	24.0	24.7	26.0
Range	11-25	14-25	15-31	15-33	15-33	17-33	20-33
No.	4	4	4	4	4	4	4
Total amino acid nitrogen (mg./100 ml.)							
Mean	3.72	2.20	1.47	2.07	2.32	2.17	2.05
Range	2.7-4.4	1.3-3.4	1.0-2.1	1.2-3.3	1.9-3.3	1.8-2.7	1.2-3.2
No.	4	4	4	4	4	4	4

TABLE 40.

INCREASE IN PLASMA GLUCOSE CONCENTRATIONS (mg./100 ml.) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST (within 2 to 3 hours) AND EIGHTH DAY OF LIFE AFTER(30 µg./kg., i.m.) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucagon administration					
		20	40	60	90	120	150
First day (within 2 to 3 hours)							
Mean	42.2	30.6	54.6	62.6	52.2	38.8	20.0
Range	23-62	12-57	27-82	46-104	28-83	3-81	-11 to 38
No.	5	5	5	5	5	5	5
Eighth day							
Mean	71.2	43.5	53.0	55.3	46.0	29.0	12.3
Range	78-106	36-48	35-62	15-72	-6 to 68	-1 to 50	-8 to 45
No.	4	4	4	4	4	4	4

TABLE 41.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS, POTASSIUM, UREA AND TOTAL AMINO ACID NITROGEN CONCENTRATIONS (MEAN) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST DAY (within 2 to 3 hours)OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucagon administration					
		20	40	60	90	120	150
Glucose (mg./100 ml.)							
Mean	43.7	67.3	83.0	96.0	89.7	77.0	71.7
Range	35-55	48-95	66-115	85-114	80-100	70-85	63-79
No.	3	3	3	3	3	3	3
Inorganic phosphorus (mg./100 ml.)							
Mean	5.86	5.20	5.13	5.00	5.20	5.40	5.27
Range	5.3-6.5	4.6-5.6	4.6-5.4	5.0	5.0-5.6	5.0-5.8	5.0-5.4
No.	3	3	3	3	3	3	3
Potassium (mEq/L.)							
Mean	5.60	5.50	5.30	4.97	5.00	5.03	5.17
Range	5.3-6.0	5.2-6.0	5.1-5.8	4.4-5.6	4.4-5.6	4.5-5.8	4.5-6.0
No.	3	3	3	3	3	3	3
Urea (mg./100 ml.)							
Mean	20.3	21.0	22.3	22.7	25.3	24.3	24.3
Range	12-31	12-32	12-33	12-33	15-36	14-33	16-31
No.	3	3	3	3	3	3	3
Total amino acid nitrogen (mg./100 ml.)							
Mean	5.07	4.27	4.43	3.87	3.53	3.00	2.87
Range	5.0-6.5	4.2-4.4	3.6-5.7	3.1-4.8	3.3-3.7	2.2-3.5	2.2-3.6
No.	3	3	3	3	3	3	3

TABLE 42.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS, POTASSIUM, UREA AND TOTAL AMINO ACID NITROGEN CONCENTRATIONS (MEAN) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE EIGHTH DAY OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucagon administration 20	40	60	90	120	150
Glucose (mg./100 ml.)							
Mean	62.0	91.7	94.3	82.7	70.3	65.7	61.7
Range	53-73	83-110	80-109	67-95	50-81	53-75	53-71
No.	3	3	3	3	3	3	3
Inorganic phosphorus (mg./100 ml.)							
Mean	4.63	3.53	3.40	4.00	4.00	4.40	4.20
Range	3.3-5.6	2.1-4.8	2.3-4.6	2.7-5.4	2.9-5.4	3.5-5.6	3.5-5.6
No.	3	3	3	3	3	3	3
Potassium (mEq/L.)							
Mean	3.53	3.20	2.93	2.93	2.70	3.20	3.27
Range	2.6-4.0	2.1-3.9	2.0-3.5	1.8-3.7	2.0-3.3	2.5-3.6	2.6-3.7
No.	3	3	3	3	3	3	3
Urea (mg./100 ml.)							
Mean	34.0	34.7	35.7	37.0	36.3	37.3	39.0
Range	17-60	20-59	22-60	22-65	21-63	22-68	22-70
No.	3	3	3	3	3	3	3
Total amino acid nitrogen (mg./100 ml.)							
Mean	3.70	3.40	2.87	2.50	2.47	2.57	2.57
Range	3.5-6.4	2.7-4.1	2.8-2.9	2.0-2.8	2.2-2.6	2.2-2.9	2.2-2.9
No.	3	3	3	3	3	3	3

TABLE 43.

INCREASE IN PLASMA GLUCOSE CONCENTRATIONS (mg./100 ml.) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST (within 2 to 3 hours) AND EIGHTH DAY OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucagon administration					
		20	40	60	90	120	150
First day (with 2 to 3 hours)							
Mean	43.7	23.6	39.3	52.3	46.0	33.3	28.0
Range	35-55	13-40	25-60	48-59	39-54	21-50	18-44
No.	3	3	3	3	3	3	3
Eighth day							
Mean	62	29.7	32.3	20.7	8.3	3.7	-0.33
Range	53-73	10-50	21-49	13-35	-3 to 20	0-9	-2 to 1
No.	3	3	3	3	3	3	3

FIGURE 12a.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS, POTASSIUM, UREA AND TOTAL AMINO ACID NITROGEN CONCENTRATIONS (MEAN) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST (▲.....▲) AND EIGHTH (Δ.....Δ) DAY OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION.

FIGURE 12b.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS AND POTASSIUM CONCENTRATIONS (MEAN) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND (▲.....▲) AND EIGHTH (Δ.....Δ) DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION.

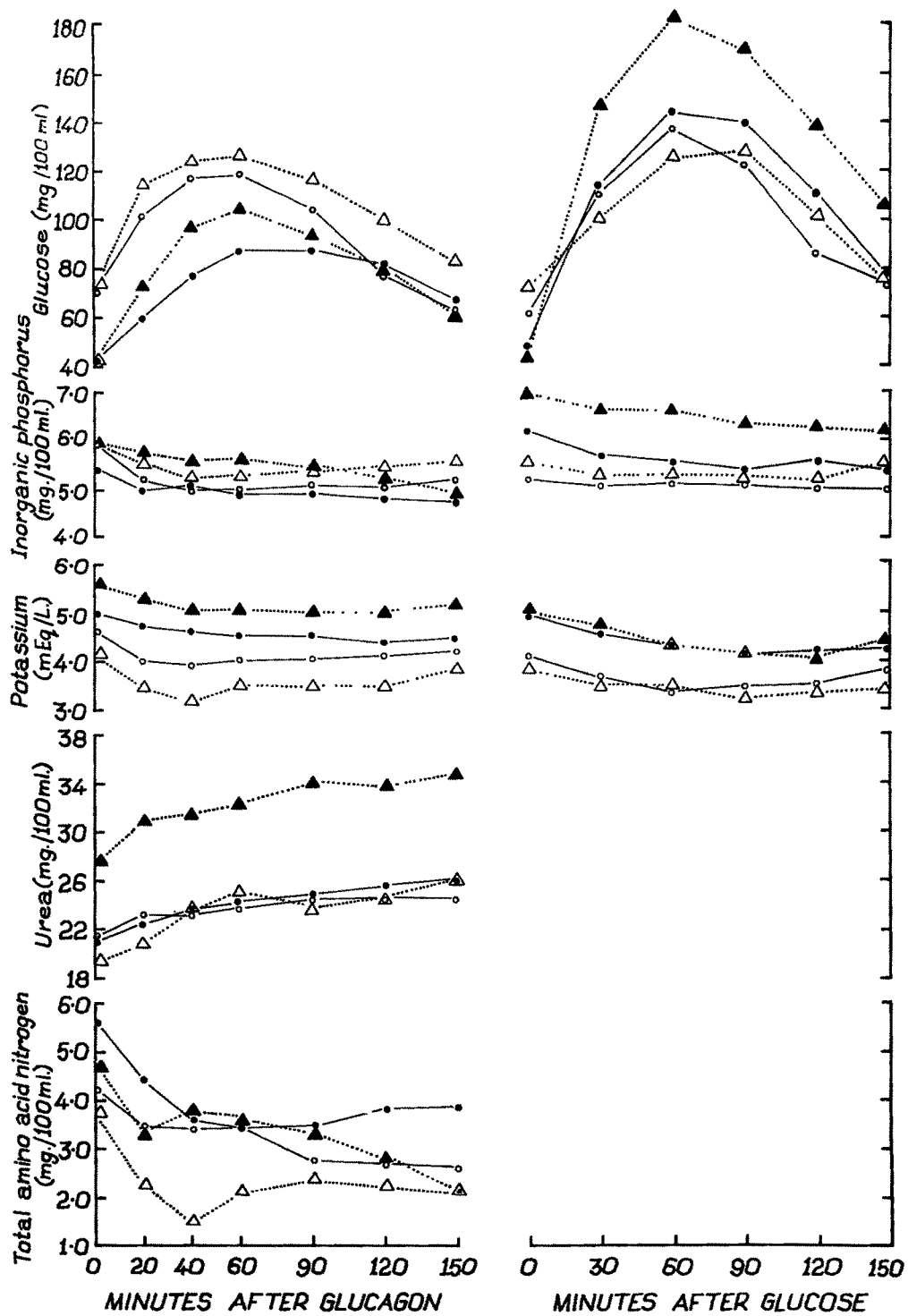
Glucose (mg./100 ml.)
180
160
140
120
100
80
60
40
Inorganic phosphorus (mg./100 ml.)
7·0
6·0
5·0
4·0
Potassium (mEq./L.)
6·0
5·0
4·0
3·0
Urea (mg./100 ml.)
38
34
30
26
22
18
Total amino acid nitrogen (mg./100 ml.)
6·0
5·0
4·0
3·0
2·0
1·0
0 20 40 60 90 120 150
MINUTES AFTER GLUCAGON
0 30 60 90 120 150
MINUTES AFTER GLUCOSE

Fig. 12a. 12b.

FIGURE 13a.

INCREASE IN PLASMA GLUCOSE CONCENTRATIONS (Δ mg./100 ml.) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST (▲.....▲) AND EIGHTH (Δ.....Δ) DAY OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION.

FIGURE 13b.

INCREASE IN PLASMA GLUCOSE CONCENTRATIONS (Δmg./100 ml.) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND (▲.....▲) AND EIGHTH (Δ.....Δ) DAY OF LIFE AFTER GLUCOSE (2.5 G./kg., oral) ADMINISTRATION.

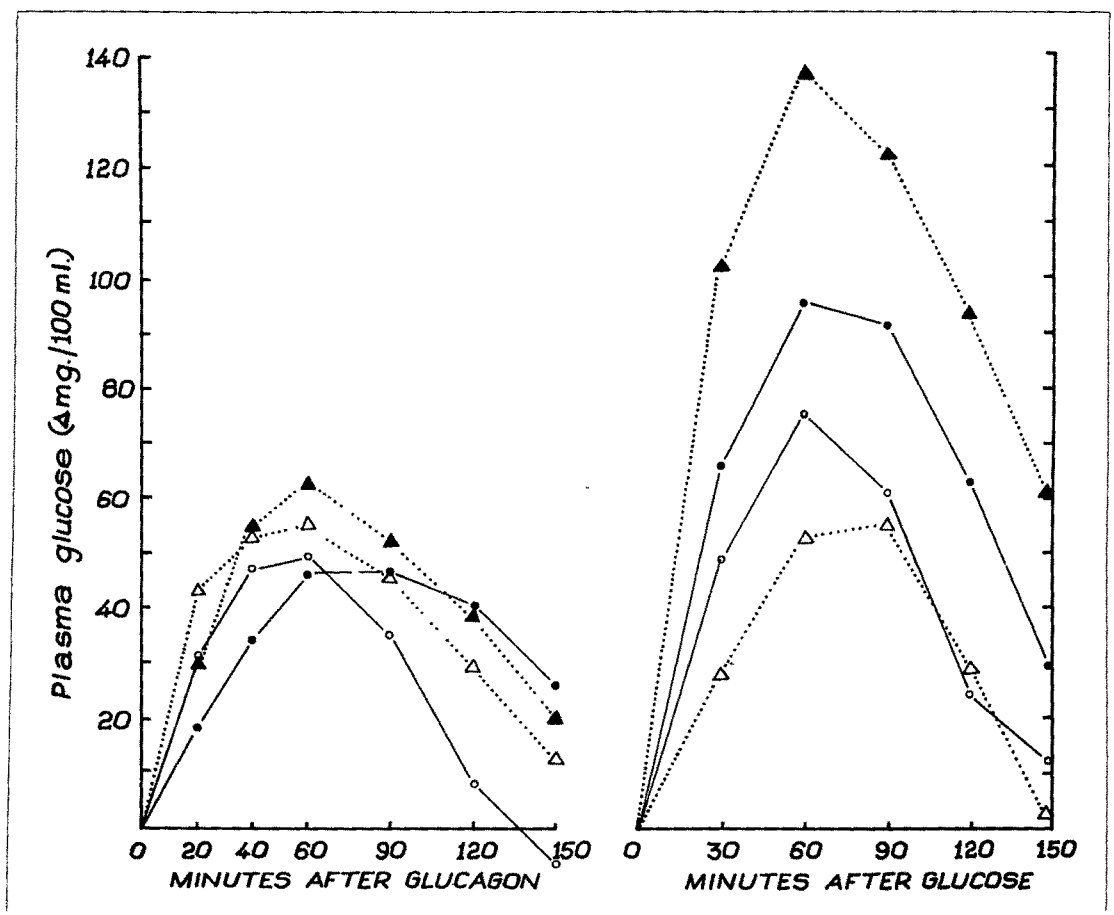
140
120
100
80
60
40
20
Plasma glucose (Δmg./100 ml.)
0 20 40 60 90 120 150
MINUTES AFTER GLUCAGON
0 30 60 90 120 150
MINUTES AFTER GLUCOSE

Fig. 13 a. 13b.

FIGURE 14a.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS, POTASSIUM, UREA AND TOTAL AMINO ACID NITROGEN CONCENTRATIONS (MEAN)OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST (■.....■) AND EIGHTH (□.....□) DAY OF LIFE AFTER GLUCAGON (30 µg./kg., i.m.) ADMINISTRATION.

FIGURE 14b.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS AND POTASSIUM CONCENTRATIONS (MEAN) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND (■.....■) AND EIGHTH (□.....□) DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION.

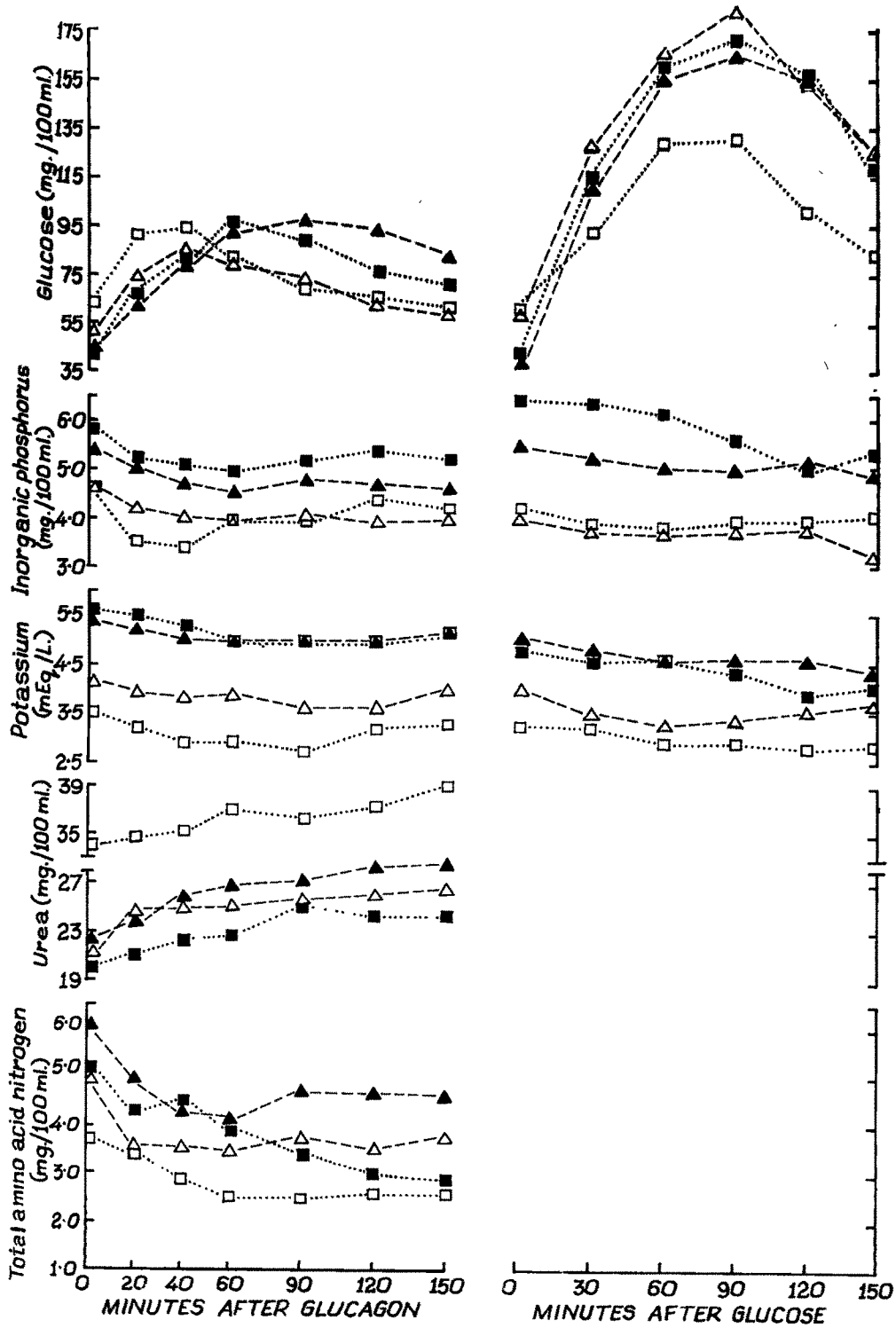
Glucose (mg./100 ml.)
175
155
135
115
95
75
55
35
Inorganic phosphorus (mg./100 ml.)
6·0
5·0
4·0
3·0
Potassium (mEq./L.)
5·5
4·5
3·5
2·5
Urea (mg./100 ml.)
39
35
27
23
19
Total amino acid nitrogen (mg./100 ml.)
6·0
5·0
4·0
3·0
2·0
1·0
0 20 40 60 90 120 150
MINUTES AFTER GLUCAGON
0 30 60 90 120 150
MINUTES AFTER GLUCOSE

Fig. 14a. 14b.

FIGURE 15a.

INCREASE IN PLASMA GLUCOSE CONCENTRATIONS (Δ mg./100 ml.) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE FIRST (■.....■) AND EIGHTH (□.....□) DAY OF LIFE AFTER GLUCAGON (30 µg./kg.,i.m.)ADMINISTRATION.

FIGURE 15b.

INCREASE IN PLASMA GLUCOSE, CONCENTRATIONS (Δ mg./100 ml.) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND (■.....■) AND EIGHTH (□.....□) DAY OF LIFE AFTER GLUCOSE (2.5 G/kg.,oral)ADMINISTRATION.

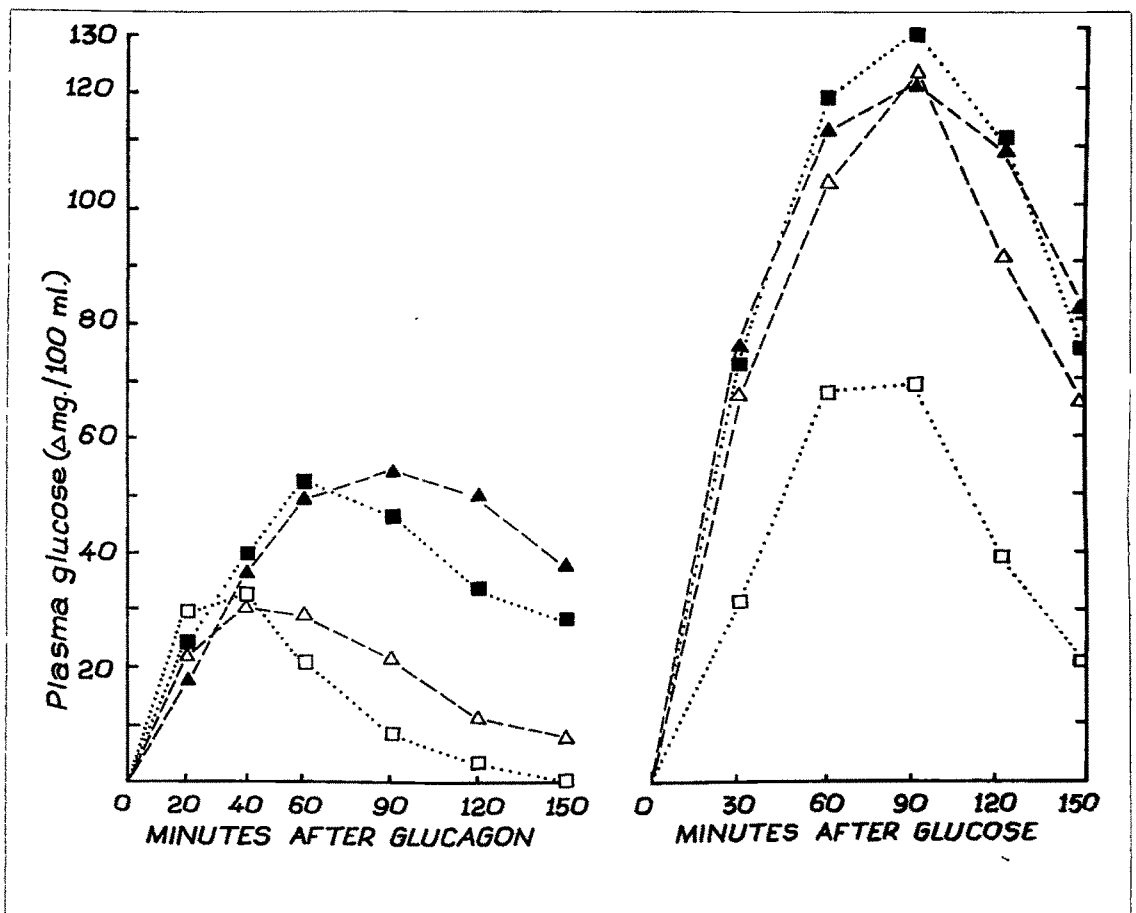
130
120
100
80
60
40
20
Plasma glucose (Δmg./100 ml.)
0 20 40 60 90 120 150
MINUTES AFTER GLUCAGON
0 30 60 90 120 150
MINUTES AFTER GLUCOSE

Fig. 15 a. 15 b.

GLUCOSE TOLERANCE TESTS

To assess the rate of glucose disappearance in the infants, who suffered intra-uterine malnourishment due to placental insufficiency, glucose tolerance tests were carried out in the same infants on the second and eighth days of life.

RESULTS:

1. Full-term infants with maternal toxaemia:

Tables 44 and 45 represent the behaviour of the plasma glucose, phosphorus and potassium concentrations on second and eighth day respectively, while Table 46 depicts the changes in the net increases of the plasma glucose levels on both these days after oral glucose administration. Fig. 12b illustrates the trends of the above mentioned parameters. The behaviour of the net increases in the plasma glucose concentrations are demonstrated in Fig. 13b.

2. Premature infants with maternal toxaemia:

Tables 47 and 48 show the results of the mean plasma glucose, inorganic phosphorus and potassium concentrations after oral glucose administration on the second and eighth day respectively. Table 49 depicts the net increases in the plasma glucose concentrations on both these days. Fig. 14b illustrates the behaviour of the above mentioned parameters while the Fig. 15b demonstrates the net increases in the plasma glucose concentrations after an oral glucose load.

Representative data as regards the behaviour of the changes in the plasma glucose and other similar parameters after glucose administration in non-symptomatic infants with maternal toxaemia are not available from the literature.

DISCUSSION:

Changes in the rate of glucose disappearance seen on the second day of life in the infants having maternal toxaemia are suggestive of deficient insulin release mechanism. The subsequent improvement in the glucose disappearance rate seen on the eighth day of life in the same infants is remarkable. Howfar these changes are related to maternal toxaemia is difficult to evaluate.

TABLE 44.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS AND POTASSIUM CONCENTRATIONS (MEAN) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral)ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucose administration 30	60	90	120	150
Glucose (mg./100 ml.)						
Mean	45.4	147.4	182.6	169.8	138.8	105.6
Range	28-62	94-190	156-228	119-277	63-269	60-228
No.	5	5	5	5	5	5
Inorganic phosphorus (mg./100 ml.)						
Mean	6.96	6.64	6.62	6.34	6.25	6.14
Range	5.3-7.9	5.3-7.8	5.3-7.6	5.1-7.3	5.2-7.3	5.3-7.1
No.	5	5	5	5	5	5
Potassium (mEq/L.)						
Mean	5.00	4.74	4.32	4.12	4.12	4.36
Range	4.5-6.0	3.8-6.0	3.5-5.9	3.4-5.6	3.0-5.4	3.6-5.3
No.	5	5	5	5	5	5

TABLE 45.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS AND POTASSIUM CONCENTRATIONS (MEAN) OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE EIGHTH DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucose administration				
		30	60	90	120	150
Glucose (mg./100 ml.)						
Mean	73.5	101.5	126.0	128.5	102.5	75.2
Range	48-107	79-117	118-134	98-146	57-127	52-123
No.	4	4	4	4	4	4
Inorganic phosphorus (mg./100 ml.)						
Mean	5.57	5.30	5.30	5.30	5.17	5.45
Range	3.9-7.0	4.0-6.7	3.4-6.8	3.5-6.8	3.8-6.8	3.9-6.8
No.	4	4	4	4	4	4
Potassium (mEq/L.)						
Mean	3.83	3.53	3.45	3.20	3.30	3.35
Range	3.0-4.6	3.0-4.6	3.0-4.6	2.9-3.8	2.9-4.6	2.8-4.6
No.	4	4	4	4	4	4

TABLE 46.

INCREASE IN THE PLASMA GLUCOSE CONCENTRATIONS (mg./100 ml.)OF THE FULL-TERM INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND AND EIGHTH DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucose administration				
		30	60	90	120	150
Second day						
Mean	45.4	102.0	137.2	124.4	93.4	60.2
Range	28-62	47-152	117-176	81-225	25-217	19-176
No.	5	5	5	5	5	5
Eighth day						
Mean	73.5	28.0	52.5	55.0	29.0	1.75
Range	48-107	6-40	35-70	31-80	-10 to 64	-1 to 27
No.	4	4	4	4	4	4

TABLE 47.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS AND POTASSIUM CONCENTRATIONS (MEAN) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucose administration. 30	60	90	120	150
Glucose (mg./100 ml.)						
Mean	42.3	114.7	160.3	171.3	153.0	117.0
Range	38-46	104-136	143-186	146-200	150-157	106-123
No.	3	3	3	3	3	3
Inorganic phosphorus (mg./100 ml.)						
Mean	6.47	6.43	6.20	5.63	5.07	5.33
Range	5.8-7.7	5.8-7.8	5.1-7.7	4.9-6.2	4.5-6.2	4.3-6.2
No.	3	3	3	3	3	3
Potassium (mEq/L.)						
Mean	4.90	4.66	4.57	4.37	3.93	4.07
Range	4.7-5.1	4.4-4.8	4.0-4.7	3.6-5.2	3.8-4.1	3.8-4.3
No.	3	3	3	3	3	3

TABLE 48.

PLASMA GLUCOSE, INORGANIC PHOSPHORUS AND POTASSIUM CONCENTRATIONS (MEAN) OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE EIGHTH DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucose administration				
		30	60	90	120	150
Glucose (mg./100 ml.)						
Mean	61.7	92.7	129.0	130.3	101.0	82.7
Range	53-71	68-114	93-168	119-152	87-116	66-99
No.	3	3	3	3	3	3
Inorganic phosphorus (mg./100 ml.)						
Mean	4.20	3.87	3.83	3.90	3.90	4.03
Range	3.5-5.6	3.1-5.2	3.1-5.2	3.2-5.2	3.2-5.2	3.3-5.3
No.	3	3	3	3	3	3
Potassium (mEq/L.)						
Mean	3.27	3.21	2.90	2.90	2.83	2.87
Range	2.6-3.7	2.7-3.7	2.2-3.3	2.0-3.5	1.7-3.5	1.8-3.5
No.	3	3	3	3	3	3

TABLE 49.

INCREASE IN THE PLASMA GLUCOSE CONCENTRATIONS (mg./100 ml.)OF THE PREMATURE INFANTS WITH MATERNAL TOXAEMIA ON THE SECOND AND EIGHTH DAY OF LIFE AFTER GLUCOSE (2.5 G/kg., oral) ADMINISTRATION. (PRESENT SERIES)

	Basal level	Minutes after glucose administration				
		30	60	90	120	150
Second day						
Mean	42.3	72.4	118.0	129.0	110.7	74.7
Range	38-46	61-90	100-148	105-162	104-119	68-80
No.	3	3	3	3	3	3
Eighth day						
Mean	61.7	31.0	67.3	68.6	39.3	21.0
Range	53-71	15-43	40-97	59-81	29-55	-5 to 38
No.	3	3	3	3	3	3

GENERAL COMMENTS

The blood glucose concentration in the foetus, is usually lower than, and fluctuates with the maternal level (Dawes, 1968).

Within a few hours after birth, the plasma glucose level falls to about 45 mg./100 ml. in the full-term normal infants, while still lower levels are observed in the premature and low birth weight infants. The fasting plasma glucose level usually begins to rise by the third day and attains an adult pattern after about a week's interval. However, similar trends are not observed in the premature and low birth weight infants and levels significantly lower than the normal group, are seen even after a week's interval. It seems that infants, of these groups take a longer time to attain the adult pattern in comparison to the normal infants. Infants of toxaemic mothers may have some sort of a preferential mechanism and the results of the present series reveal that the normal homeostasis is achieved by them in about a week's time.

In spite of a large variation in the hyperglycaemic response to the glucagon dose in the individual infant, the respective group of the infants reflected an adequate glycogen stores on the first day of life. This hyperglycaemic response can roughly be attributed to the hepatic glycogen stores, since the contribution of the glucose by gluconeogenetic pathway may be assumed to be the least, in view of the

underdevelopments of the gluconeogenetic enzymes as reported by Shelley (1969). The glycogen stores seem to be readily available.

On the eighth day, the hyperglycaemic response after glucagon, gives an impression of an augmented hepatic glucose output. However, the gluconeogenetic activity could be variable and may be lower in the premature and low birth weight infants. Thus in the presence of available hepatic glucose output and presumably the hepatic glycogen stores, low fasting plasma glucose concentration in the newborn infant does not favour a primary importance of the hepatic glycogen stores in maintaining the circulating glucose concentration. During the early neonatal period, the physiological factors affecting removal of the blood glucose from the circulation, include the abilities of various organs to utilize glucose either dependent or independent of insulin action. A decreased rate of glucose disappearance on the second and its improvement on the eighth day speak in favour of a slow and a gradual improvement of the insulin releasing mechanism on the subsequent days. However, the rate of glucose uptake by the organs independent of insulin action cannot be understimated. Proportionately larger brain as a substantial glucose consumer and a relatively smaller liver as a principal glucose supplier may lead to a reasonly lower blood glucose concentration (Cornblath et al., 1963).

It is interesting to note that the infants having their birth weight lower than the average normal limit (2500 G) show:, a considerable divergence in the rate of glucose disappearance both on the second and eighth days. The rates of glucose disappearance on both these days in the premature infants are considerably lower than those observed in the group of low birth weight infants. There is only a slight improvement in the glucose disappearance rate on the eighth day in the premature infants, while that in the low birth weight infants is nearer to that of the normal full-term infants. Thus the differentiation between the two groups is highly justified and the utility of these observations might be helpful in the rational management of the calorie intake of such infants.

The rate of glucose disappearance seems to be related to the insulin concentration released by the pancreas. Insulin is present in the human pancreas as early as the thirteen week of gestation (Adam, Teramo, Raiha, Gitlin and Schwartz, 1969). In utero, the foetus is supplied glucose and other metabolites via placenta. In normal mothers, the blood glucose concentration invariably varies within a narrow range and thus foetal pancreas is not exposed to the adequate hyperglycaemic stimulation (Bowie et al., 1963). This state seems to be continued even after birth. Thus after delivery the newborn infant may be relatively deficient in its insulin output. During this period an exogenous glucose load is

removed slowly until insulin output and hepatic control are restored. It has been generally agreed that the slow rate of glucose disappearance is a reflection of an inadequate insulin output.

The normal infant is able to deal with the glucose load more readily if stimulated by a priming dose (Isles et al., (1968). This condition has been compared to the infant of a diabetic mother, who has received multiple priming loads during the period of gestation. Hyperinsulinism of the infant of the diabetic mother is the result of hyperglycaemia of the mother which had stimulated the islets of the foetal pancreas (Isles et al., 1968).

The low initial insulin activity (Pildes et al., 1969), the inadequate insulin output after intravenous glucose administration (Baird and Farquhar, 1962; Bowie et al., 1963), the late insulin release after an oral glucose load (Pildes et al., 1969) and the results of the oral glucose tolerance tests of the present series give an impression that the insulin release mechanism in the infants of non-diabetic mothers is not as efficient as that of an adult or an older child. This also seems to be true in most of the premature, low birth weight and toxaemic mothers' infants. However, in few of the unhappy incidences of hypoglycaemia the cause has been attributed to an abnormal or inordinately sensitive insulin release mechanism (Cornblath et al., 1964; Schiff and Lowy, 1968; Le Dune, 1972a). Tolbutamide load tests in such

cases showed a lowering of the plasma glucose concentration and thus suggested of an incordinate insulin release mechanism (Cornblath et al., 1964). Le Dune (1972a) studied intravenous glucose tolerance and plasma insulin activities in hypoglycaemic and non-hypoglycaemic small-for-date infants. He found an increased rate of glucose disappearance (KG) in all the cases of hypoglycaemia but was not able to correlate this with the insulin concentration in the peripheral plasma except in a few cases. However, insulin concentration in the peripheral plasma sample does not reflect truely the pancreatic activity (Gentz et al., 1969). The determination of pancreatic vein plasma insulin may give a better idea about the pancreatic response.

It would be evident from the above discussion that the glycogen stores in the neonatal infant are fairly adequate. Furthermore, the insulin release mechanism although active is more or less deficient during the early postnatal days. This is more marked in the premature infants. However, this appears to be counteracted by a larger size of brain in the normal and low birth weight newborn infants as compared to the adults which demands more glucose for its metabolic activities. Howfar the liver would be able to cope up with this increased demand depends upon its ability to mobilize glycogen stores and its efficacy of neoglucogenetic activity. Recently attention has been focussed to the importance of the ratio of insulin: glucagon (I/G) for maintaining an

efficient glucose homeostasis (Unger, 1971). An exogenously administered dose of glucagon is capable of producing an adequate hyperglycaemic response in the neonatal infant, which is quicker by the eighth day, thus reflecting active glycogenolytic and neoglucogenetic processes - the later showing an improvement by the eighth day. This is also supplemented by the changes observed in the TAN and urea concentrations in the present series. However, whether the insulin: glucagon ratio in the neonatal infant is adequate to maintain a normoglycaemic status is difficult to assess in absence of any available data on these important parameters for glucose homeostasis. Simultaneous determinations of glucagon and insulin levels on the pancreatic vein plasma samples during the early postnatal days would be very helpful to throw further light on this ambiguous problem.