Title: GLUCOSE UTILIZATION DURING C.P.B. IN PAEDIATRIC PATIENTS.

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Introduction: In recent years there has been a tendency towards earlier correction of major congenital abnormalities. Operations previously undertaken only in older children are now performed at any time after birth.

Established techniques of cardiopulmonary bypass (C.P.B.) have therefore been adapted for application to infants. The effects of C.P.B. on glucose metabolism and insulin response have been studied in adults 1) and older children, 2) but the effects in infants and young children have not been determined. This study is concerned with the utilization of the glucose load imposed by C.P.B. in paediatric patients.

Methods: Ten children, aged 3-81 mos., undergoing corrective cardiac surgery with C.P.B. were studied (with the consent and approval of the Surgeon-in-Chief and Director of Anaesthesia, M.C.H.). No changes were made in the routine peri-operative management. C.P.B. involved the use of pump priming solution of 500ml whole blood mixed with 250-800 ml diluent containing 5% dextrose (glucose load = 1.21-4.3g/Kg).

Repeated arterial blood samples were taken during operation for the determination of blood glucose, serum potassium and plasma insulin concentrations by standard micromethods. The first sample was taken after the induction of anaesthesia and then at intervals during surgery, 2hr. after completion of surgery and the following morning.

The blood glucose concentrations after the commencement of C.P.B. were plotted semilogarithmically against time. Regression analysis showed linear relationship between the fall of blood glucose concentration and time. From this the glucose utilization constant (K) 3) was calculated for each case from the equation:

$$K = \frac{\log_e 2}{t_{1/2}}$$

Where $\log_e 2 = 0.69315$ and $t_{1/2}$ = time in min. to reach half the maximum blood glucose concentration.

Results: The patterns of changes in blood glucose, potassium and insulin were similar in all cases. There was a marked increase in blood glucose at the commencement of C.P.B. to 1070±63.5 mg/dl which decreased rapidly over the first 10-15 min. and was then followed by a slower fall. At the end of surgery blood glucose concentrations remained high (510±62 mg/dl), but by the following morning had decreased to 102±5.3 mg/dl, within the normal range. Glucose utilization during surgery was low (K=0.62±0.07).

Serum potassium concentration decreased briefly with the onset of perfusion but then did not change during the study period.

The hyperglycaemia did not elicit an insulin response during C.P.B.; plasma insulin concentrations did not increase until the end of surgery or the early recovery period.

PT no	AGE mos	WT Kg	GL.LD g/Kg	BLOOD GLUCOSE mg/dl max	end op	next day	K
1	12	8.3	1.21	646	361	118	0.50
2	81	19.5	2.05	1134	423	133	0.83
3	63	17.4	1.44	1274	222	101	0.64
4	04	4.6	4.30	948	578	94	0.30
5	03	4.8	3.13	1140	598	112	0.58
6	47	16.0	1.70	1158	498	71	0.74
7	36	12.0	2.08	1005	388	109	0.68
8	16	12.3	2.03	898	450	99	0.79
9	15	9.0	2.78	1326	636	92	0.89
10	10	7.9	3.17	1170	942	95	0.22
			Mean	1070	510	102	0.62
			SEM	±63.5	±62	±5.3	±0.07

Table Glucose Utilization during CPB

Discussion: Glucose utilization during C.P.B. in these patients was markedly lower than the normal range in infants (K=2.6-3.6) 3 as a result of the minimal insulin response induced by hyperglycaemia. These results do not support the hypothesis that the metabolic response to surgery in small children differs qualitatively or quantitatively from adults 4. The lack of insulin response and reduced glucose utilization explain why the serum potassium concentration did not decrease when a large glucose load was imposed during surgery.

References:

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