COMPARISON OF ORAL GLUCOSE-TOLERANCE TESTS AND SERUM INSULIN RESPONSES IN PELLAGRA AND KWASHIORKOR*

J. G. PRINSLOO, E. J. P. DE BRUIN, NICO LAUBSCHER, L.M. VENTER AND H. KRUGER, *Medical Research Council, S.A. Atomic Energy Board and Council for Scientific and Industrial Research, Pretoria*

SUMMARY

Oral glucose-tolerance tests were conducted and the serum insulin responses were measured on admission as well as after clinical recovery in 8 pellagrous children and 12 with kwashiorkor. There were wide variations in the response of individual patients, but, on the whole, the kwashiorkor group had a more disturbed glucose tolerance and poorer insulin response than the pellagra group. Average fasting serum insulin levels were higher than those reported for normal children and the insulin response increased from admission to recovery. No significant differences were found between the 2 groups (on admission as well as after recovery), or between the values of the same group from admission to recovery.

Several reports have appeared indicating a disturbed carbohydrate metabolism in patients suffering from kwashiorkor.[1-6] These patients are prone to bouts of hypoglycaemia, and oral glucose-tolerance tests showed a delayed but sustained response. The disappearance rate of glucose after intravenous administration was retarded in kwashiorkor but normal in marasmus.[1] Fasting serum insulin levels have been reported as low,[2] normal or high,[3] and the serum insulin response after oral or intravenous glucose was diminished in the majority of cases.[6] Adult pellagrins showed a diminished oral glucose tolerance and impairment of disposal after the intravenous test.[7] As far as we could ascertain, results of glucose-tolerance tests and serum insulin responses in children suffering from pellagra have not been published previously. It was decided to investigate this aspect in pellagrous children and to compare the results with those obtained in cases of kwashiorkor.

MATERIAL AND METHODS

Oral glucose-tolerance tests and serum insulin responses were done on 12 kwashiorkor and 8 pellagrous children, all manifesting the classical signs, including overt oedema and hypoalbuminaemia in the former and the typical skin lesions (without oedema) in the latter group.[8] The ages of the kwashiorkor children varied between 1 and 6 years, with an average of 2 years and 10 months, and in the pellagra group from 5 to 10 years, the average being 6 years and 11 months.

Glucose was given orally in a dose of 2 g/kg bodyweight after an 8-hour fast. Venous blood samples were taken in the fasting state and at half-hourly intervals up to 2 hours after glucose intake. The tests were done within 3 days of admission and repeated after clinical recovery (at least 4 weeks after admission). Glucose was determined in a standard Technicon Auto-analyser by means of reduction of potassium ferricyanide as originally described by Hoffman,[9] and serum insulin† according to the double antibody method of Hales and Randle.[10] The glucose and insulin values of the pellagra and kwashiorkor groups, on admission as well as after recovery, were compared with each other for significant differences at the 5% level of significance using variance analyses.[11] The same tests were done in both groups to ascertain significant differences between their respective admission and recovery values.

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†To increase the accuracy of the assay the following additional steps were taken: (*i*) 4 tubes were set up for each concentration of the standardized insulin; (ii) 10 different concentrations of insulin were used (instead of 4 as suggested) to obtain the points for drawing the standard curve; (*iii*) all estimations were done in triplicate; (*iv*) as a control, insulin concentrations in duplicate serum samples were determined from time to time on different days with different batches of standardized insulin.

RESULTS

The average values of blood glucose and of serum insulin responses after oral glucose in the kwashiorkor and pellagra groups can be seen from Fig. 1 and Table I, which also indicates the standard deviations. On admission, kwashiorkor patients had, on the whole, a slower decline of peak glucose levels and a weaker insulin response than pellagra patients. After clinical recovery, kwashiorkor patients had a 'flatter' glucose tolerance curve with lower peak values than on admission, whereas the curves of the pellagra patients appeared similar on both occasions. In the kwashiorkor group peak insulin levels after recovery occurred earlier, but were only slightly higher than on admission, whereas in the pellagra group the insulin re-

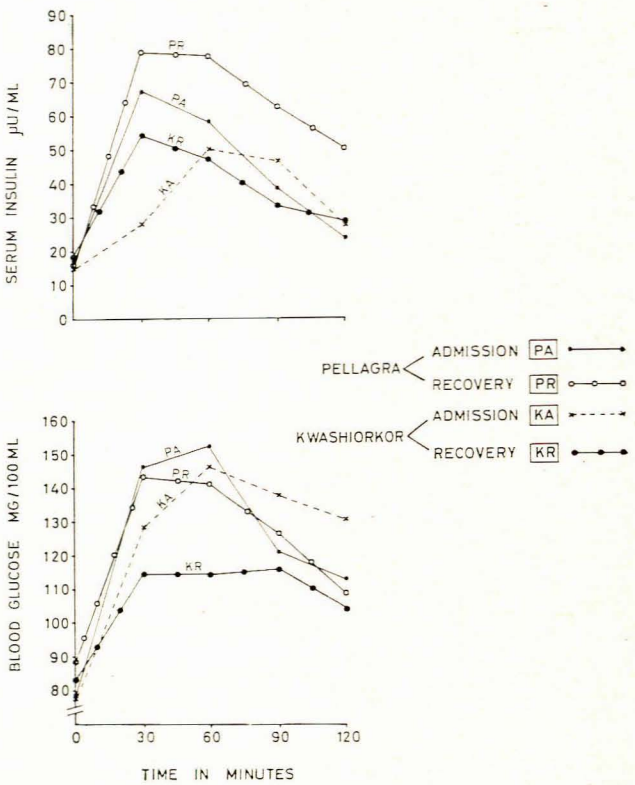

Fig. 1. Oral glucose tolerance and corresponding serum insulin curves after admission and recovery in children suffering from pellagra and kwashiorkor (average values of groups).

TABLE I. ORAL GLUCOSE-TOLERANCE TESTS AND SERUM INSULIN RESPONSES IN CHILDREN WITH PELLAGRA AND KWASHIORKOR (AVERAGE VALUES OF GROUPS)

			Glucose (mg/100 ml) average value and SD				*Insulin (μU/ml) average value and SD*				
	Time of test	*No. of patients*	*Initial reading*	*After 30 min*	*After 60 min*	*After 90 min*	*After 120 min*	*Initial reading*	*After 30 min*	*After 60 min*	*After 90 min*	*After 120 min*
Kwashiorkor	On admission	12	78·0	128·3	146·4	138·0	130·4	15·3	28·2	49·8	46·5	27·8
			(18·8)	(25·4)	(25·9)	(28·6)	(36·1)	(11·5)	(29·2)	(89·4)	(67·6)	(15·2)
	After recovery	12	83·4	114·9	114·9	116·5	104·7	17·5	54·3	47·5	33·4	28·3
			(10·6)	(20·3)	(23·5)	(27·0)	(20·1)	(13·1)	(94·0)	(61·6)	(24·6)	(13·0)
Pellagra	On admission	8	78·5	146·6	152·3	121·3	113·1	16·8	67·5	58·3	38·4	23·9
			(14·0)	(29·9)	(31·6)	(35·4)	(46·0)	(6·8)	(57·0)	(49·0)	(29·5)	(10·8)
	After recovery	8	88·5	143·5	141·1	126·9	109·3	16·1	79·0	77·9	62·5	50·1
			(10·2)	(24·9)	(29·8)	(25·1)	(16·0)	(2·8)	(46·9)	(63·6)	(25·8)	(36·3)

sponse seemed to be more clearly increased with a delayed decline after recovery as compared with the admission values. However, neither the kwashiorkor nor the pellagra group showed significant differences in glucose or insulin responses from admission to recovery. Furthermore, no significant differences were found either on admission or after recovery when the glucose and insulin values of the pellagra group were compared with those of the kwashiorkor group.

DISCUSSION

The results of oral glucose-tolerance tests and serum insulin responses vary considerably in normal individuals.[12-14] However, the fasting insulin levels of both groups, both on admission and after recovery, were higher than those reported by Grant[15] for normal children of comparable age.

According to Berson and Yalow[12] the *average* peak insulin level in adults after 100 g glucose by mouth is about 100 - 140 μU/ml. Adopting *these values* for children as well, the average secretory response of both groups was diminished on admission as well as after recovery, more so in the kwashiorkor than in the pellagra patients, and some improvement took place after clinical recovery. On the other hand, in the light of the wide variations in normal insulin secretory response,[16-19] and the suggestions for interpreting these,[17] the insulin values of our patients could still be considered to fall within the normal range. The results of the oral glucose tolerances of the kwashiorkor group are in accordance with the findings of others.[2,6,20] The average glucose values are almost identical with those reported by Pimstone *et al.*[20] in Cape Coloured children with kwashiorkor. Considering a 2-hour venous blood value of 110 mg/100 ml as the upper limit of normal,[12] the kwashiorkor group had a 'diabetic' type of response on admission but not after recovery, although at the latter stage there seemed to be a 'flat' tolerance curve. The pellagra group's average glucose-tolerance curves appeared to be about normal, with the average 2-hour blood-glucose level just above 110 mg/100 ml on admission and just below 110 mg/100 ml after recovery. On admission 9 of the 12 kwashiorkor patients had abnormal 2-hour glucose levels (in comparison with 4 of the 8 pellagrins) and after recovery 5 had abnormal 2-hour values (while still 4 of 8 pellagrins had abnormal levels). The fact that no significant differences were found between the 2 groups might be due to the relatively small number of experimental subjects as well as to the great variability in the responses of invidual patients in both groups which resulted in an overlap of values. Whether pellagrous children do in fact dispose of glucose at a more normal rate than kwashiorkor patients will be solved by performing intravenous glucose-tolerance tests and thus avoiding possible absorptive differences between the groups. Such studies are at present being undertaken.

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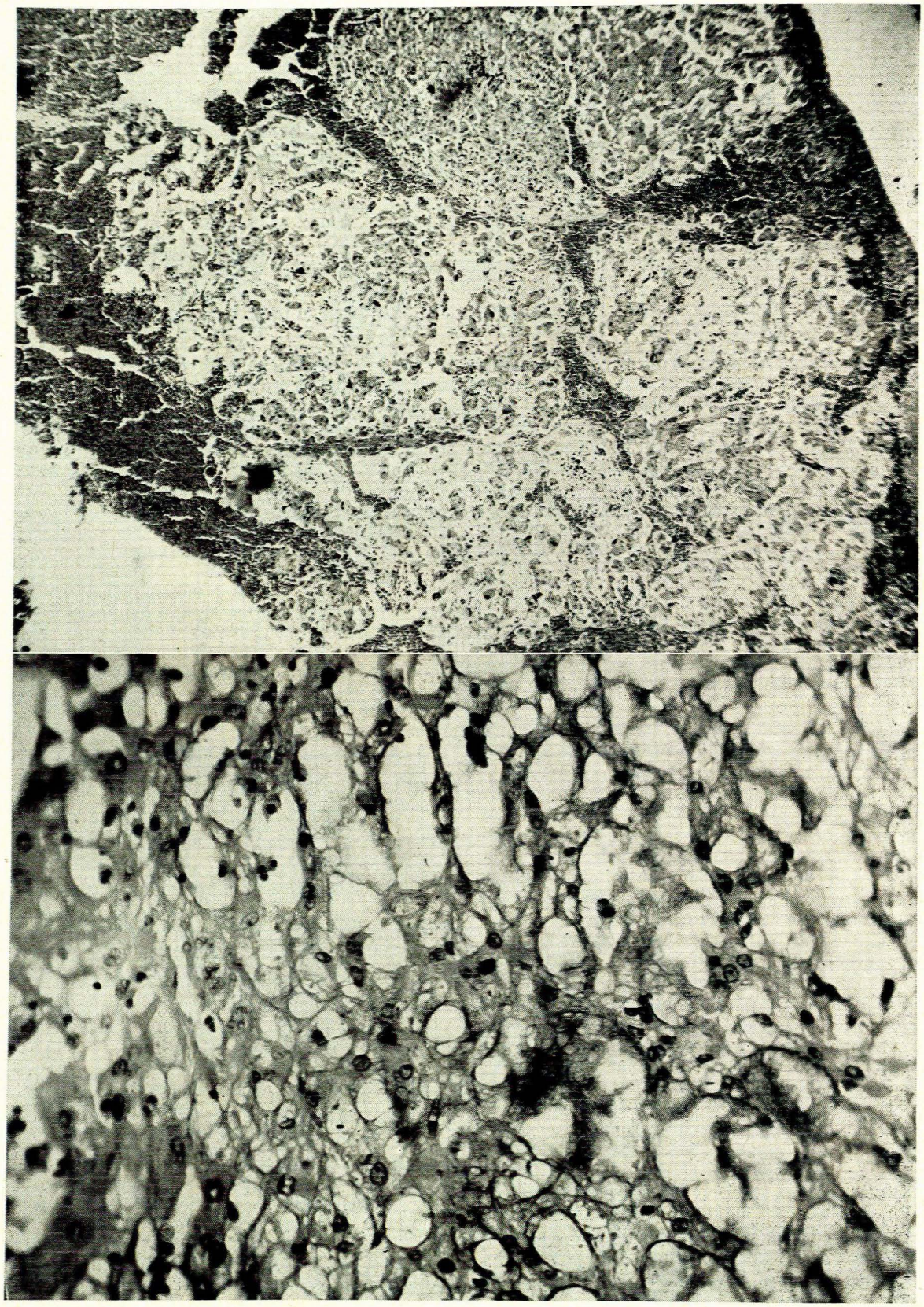

Fig. 1.