CALCIUM, PHOSPHATE AND PHOSPHATASE IN MONGOLISM

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BENDA (1947) has reported values falling within the normal range for the serum calcium, phosphate and alkaline phosphatase in mongolism. More recently however Sobel *et al.* (1956) have stated that, while the inorganic phosphate and phosphatase are normal, the serum calcium is low in mongolism. The data on which this report was based do not appear to have been published to date. Further information on this point therefore seemed desirable.

CLINICAL GROUPS

Forty children with mongolism and an equal number of children with other forms of mental retardation were included in the investigation. Details are given in Table I. "Unclassified" here means that the mental defect could not be attributed to any one specific cause. The patients with cerebral palsy had also had one or more epileptic fits while in hospital. All the children had been in-patients at the Fountain Hospital for two months or longer and were in good health at the time of investigation. The diet consumed was well balanced and adequate in vitamins. Its composition was the same for all patients, only the consistency varied, depending on the child's ability to chew.

TABLE I

Classification of Cases

Mongolism	40
Unclassified	21
Microcephaly	9
Epilepsy	4
Cerebral palsy	3
Icterus gravis neonatorum	2
Hydrocephalus	1
Total	80

	Children with Mongolism	Controls
Mean age	7 years 3 months	7 years 4 months
Age range	2 years 5 months–12 years 4 months	2 years 7 months–12 years 11 months
Mean I.Q.	34	31
I.Q. range	10·62	3·67

METHODS

Collection of Samples

About 0·5 ml. of capillary blood was obtained from a finger prick and allowed to clot in a 3/8 inch tube. The serum was separated within one hour by centrifuging for 10 minutes at 2,500 rev./min. and aliquots de-proteinized

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immediately with trichloroacetic acid for the estimation of the inorganic phosphate. Samples were always collected alternatively from children with mongolism and controls so that the time the samples were allowed to stand before separation was the same for both groups.

Chemical Methods

Calcium was estimated on 0·1 ml. of serum by the method of Stern and Lewis (1957a).

Inorganic phosphate was determined on 0·025 ml. of serum according to Weil-Malherbe and Green (1951) using one-quarter quantities of all reagents and a 1:1 mixture of *iso*-butanol benzene for the extraction of the molybdate complex.

Alkaline phosphatase was estimated on 0·04 ml. of serum by the method of King and Wootton (1956) scaled down by a factor of five, and acid phosphatase on 0·1 ml. according to the same authors with one half the volume of serum and one-fifth the volume of all other reagents.

Results

A summary of the results obtained is given in Table II. The children with mongolism had a serum calcium level over 7 per cent. lower than that of the controls, the difference being highly significant statistically. The calcium level of the control group in its turn was lower than that of normal adults employed at the Fountain Hospital, 25 of whom were found to have a mean serum calcium level of $9 \cdot 78 \pm 0 \cdot 06$ (S.E.) mg./100 ml. compared to $9 \cdot 51 \pm 0 \cdot 07$ (S.E.) mg./100 ml. for our control group. The difference of 0·27 mg./100 ml. is significant ($t > 2 \cdot 660$, $P < 0 \cdot 01$).

The serum inorganic phosphate was significantly higher in the children with mongolism than in the controls. No age effect on the serum phosphate was demonstrable nor were significant differences established in the levels of the alkaline and acid phosphatases of the two groups.

Discussion

The range and mean level of the alkaline phosphatase for the children with mongolism and the controls are reasonably close to values reported for normal children (Harrison *et al.*, 1948), as are the range and mean level of the acid phosphatase (Tuba, Cantor and Siemens, 1947). There is some uncertainty about the "normal" serum calcium level in children. Wilkinson (1957) found a mean level of $9 \cdot 72 \pm 0 \cdot 02$ (S.E.) mg./100 ml. for a group of 710 children using E.D.T.A. titration. This is about 2 per cent. higher than the value for our control group. This difference is probably in part due to the serum protein level in children at the Fountain Hospital (Stern and Lewis, 1957b) being 0·3 mg./100 ml. lower than that in normal children (Beach *et al.*, 1948). On the other hand the differences in the serum proteins between children with mongolism and other mentally retarded children at the Fountain Hospital (Stern and Lewis, 1957b) are clearly too small to account for the observed differences in the calcium levels.

The lowered calcium and raised phosphate in the children with mongolism cannot be satisfactorily explained by hypofunction of the pituitary or thyroid which have from time to time been said to form part of the syndrome of mongolism, nor is there at present any evidence of a defect in calcium absorption or impairment of renal function which could give rise to the serum

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TABLE II

Calcium, Inorganic Phosphorus, Alkaline Phosphatase and Acid Phosphatase in the Serum of Children with Mongolism and of Other Mentally Retarded Children as Controls
Significant Differences ($P<0·05$) are shown in Italic Type

	Children with Mongolism				Controls				Significance of Differences		
	N	Range	Mean	S.E.	N	Range	Mean	S.E.	Δ	t	P
Calcium .. .. .. (mg./100 ml.)	40	8·2– 9·3	8·8	0·05	40	9·1–10·4	9·5	0·07	*0·7*	>3·460	<0·001
Inorganic phosphorus .. (mg./100 ml.)	40	3·3– 6·5	5·0	0·10	40	3·0– 6·1	4·7	0·09	*0·3*	>2·000	<0·05
Alkaline phosphatase .. (K A units)	26	10·8–26·8	18·1	0·89	26	8·7–28·4	17·3	1·16	0·8	<0·679	>0·5
Acid phosphatase .. .. (K A units)	35	1·8– 3·7	2·8	0·09	27	1·7– 4·4	3·0	0·12	0·2	<1·658	>0·1

chemistry. In hypoparathyroidism the calcium is low and the inorganic phosphate high, but the serum changes described in this condition while qualitatively similar are much more pronounced than those reported here. The endocrine glands are said to be generally under-developed in mongolism (Benda, 1947) and the possibility cannot therefore be excluded that the control of calcium metabolism by the parathyroids is less efficient in these patients than in the controls. Alternatively our findings may reflect a metabolic abnormality in mongolism not yet understood.

SUMMARY

The serum calcium was found to be significantly lower and the serum inorganic phosphate higher in a group of forty children with mongolism compared to an equal number of children with other forms of mental retardation. No significant differences were found in the level of the serum alkaline and acid phosphatases.

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