LINES OF ARRESTED GROWTH IN THE LONG BONES OF DIABETIC CHILDREN

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(With Special Plate)

During the last seven years the rate of growth of the long bones in health and disease has been studied radiographically with a view to ascertaining the susceptibility of bone to nociceptive influences.^{1 2 3} As the acute exanthemata in children consistently produced an arrest of growth which was accurately registered in the radiograms of the long bones, the problem arose whether the metabolic disturbance of growth was due to pyrexia, anhydraemia, or deficiency or unsuitable intake of food. Accordingly opportunity was taken to examine cases of disease presenting no pyrexia. Diabetic children were therefore examined radiographically, with the result that multiple lines of cessation of growth were found to be a constant feature whenever the disease was of long standing. Three cases have been selected as illustrative of the simultaneous control by insulin of the disease and of growth.

CASE I

A girl, aged 13, was brought to the Mayo Clinic in March, 1924, with a history of an acute onset of diabetes three weeks previously. The condition was controlled by the administration of 10 units of insulin night and morning. Owing to the occurrence of abnormal variations in the general condition, the parents permitted the child to go to hospital for subsequent periods of about ten days in October and November, 1924, in May and June, 1925, and in June, 1926. A radiogram of the knee-joint of this patient, for which I am indebted to Dr. Russell M. Wilder, displays multiple lines of arrested growth (Fig. 1, Special Plate). In May, 1925, a note was made by Dr. Wilder that the patient was "following the regime reasonably conscientiously, and has been sugar-free at all times except twice after dietary indiscretions." Menstruation began in November, 1925, and was regular until March, 1926, then influenza was followed by dysmenorrhoea and amenorrhoea. A radiogram of the chest showed healed tuberculosis of the upper left lobe.

The radiogram shows more than ten transverse lines in the diaphysis of the femur and of the tibia. Obviously, the clinical history is not sufficiently detailed or accurate to determine those lines of cessation of growth due to influenza, those to uncontrolled diabetes, those to dietary excess whilst taking insulin, and those to negligence in regularity of the insulin treatment. The multiplicity of the lines indicates the variations in the rate of growth in the patient, negatives the view that the lines are seasonal, and illustrates the difficulties involved in ascribing to a given line the exact cause of the arrest of growth.

CASE II

A girl, aged 12, was under the care of Professor T. R. Elliott for a period after August, 1923, when she was admitted to hospital with glycosuria. Insulin was administered and the glycosuria was controlled. The patient was readmitted in October, 1923, in May and July, 1924, in March, August, and October, 1927. Throughout the period the glycosuria was fairly well controlled. Any failure brought the child to hospital for further alteration in the diet or in the insulin dosage. The only acute infection suffered by this child was chicken-pox in March, 1927.

The radiogram (Fig. 2, Special Plate) taken in November, 1927, shows a series of distinct transverse lines of arrested growth. Eight transverse lines can be clearly identified on the radiogram, and these correspond closely with the seven admissions to hospital and the one attack of chicken-pox.

CASE III

A boy, aged 6½, was admitted to hospital in January, 1928. He had an excessive appetite, much thirst, and was losing flesh. Sugar had been detected in the urine one week previously, when he developed an attack of diabetic coma. This child, formerly very bright and active, had no experience of illness until he was four years old, when he had chicken-pox, with attacks of "asthma," which appeared frequently as an expression of any slight "cold." The boy had mumps in May, 1925, and severe measles in April, 1926. He responded well to insulin treatment, and now, at 7 years of age, weighs 55 lb.

A radiogram of the knee-joint, taken in January, 1928, shows a well-marked line of arrested growth in the diaphysis of the femur and of the tibia at a distance of about 1.5 cm. from the epiphyseal cartilage. This distance corresponds to the average amount of growth in the shaft at this age for a period of fourteen to twenty months, and one is justified in suggesting that this line is attributable to the attack of measles in April, 1926. Between the epiphyseal cartilage and the diaphysis is a band of dense calcareous deposit due to the arrest of growth resulting from the acute attack of diabetes. It will be of interest to watch this child further.

COMMENTARY

Lines of arrested growth in cases of diabetes were shown before the Anatomical Association in 1926,¹ and again by Professor Elliot Smith⁴ in the same year. In September, 1927, Morrison and Bogan,⁵ in the routine examination of sixty-eight diabetic children, discovered thirty-six cases with multiple transverse striae. They state that the transverse striae of the long bones are found in a larger percentage of diabetic than of normal children, but failed to associate the transverse lines with the onset of the disease. It is obvious that for the explanation of cases presenting multiple lines a complete clinical history of all infectious diseases, both severe and mild, is essential, since it has already been shown that the bone registers the arrest of growth to an extent which is more delicate in many cases than the subjective symptoms of the patient.

Radiographic examination of the long bones at stated intervals is a valuable means of recording the repeated arrests of growth in children suffering from metabolic diseases such as diabetes. The lines of arrested growth tend to persist in the bones adjoining joints with a movement essentially monaxial—for example, ankle or knee. The bony lines of arrested growth are absorbed rapidly at the wrist and elbow in accordance with the rapid remodeling in an area subjected to bending strains and torts. Moreover, the rate of absorption is determined largely by the degree of function, so that the bed-ridden child tends to preserve these lines in the bones of the lower limb, whereas in the upper limb the movements involved in eating, playing, and fidgeting lead to rapid absorption of the lines of dense bone in conformity with the continuous process of change which characterizes the functional use of the part.

REFERENCES

- ¹ Harris, H. A.: *Arch. Int. Med.*, 1926, xxxviii, 785.
- ² Idem: *Lancet*, September 8th, 1928, 489.
- ³ Idem: *Quart. Journ. Med.*, 1928, xxi, 499.
- ⁴ Smith, Elliot: *Lancet*, November 6th, 1926, 943.
- ⁵ Morrison and Bogan: *Amer. Journ. Med. Sci.*, 1927, lxxiv, 313.

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FIG. 1.—Radiogram of the knee of a diabetic girl of 13, showing multiple lines of arrested growth in the metaphysis of the femur and tibia.

FIG. 2.—Radiogram of the tibia of a diabetic girl of 12, showing lines of arrested growth in the bone.

R. S. JOHNSON AND R. R. ARMSTRONG: PNEUMONIA TREATED BY CONCENTRATED ANTIPNEUMOCOCCAL SERUM

FIG. 1.—Radiogram of chest showing pneumonia of left base and also an inflammatory lesion of the right mid and lower zones.

FIG. 2.—Specimen of left lung, collapsed and empty on the fifth day of disease. The fibrin envelope has been partly stripped to show the wrinkled surface of the lung.