ELECTROCARDIOGRAPHIC STUDIES IV

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Case 4. Acute Hypokalaemia with Secondary Renal Changes and Renal Insufficiency.

This patient, a Coloured female aged 45 years, had been quite well until 6 months before her admission to hospital. She then noticed some swelling of her ankles and became unduly fatigued. These were the only complaints until 2 months before admission when she began to vomit, particularly after meals. Three weeks before admission she also developed abdominal colic and had a persistent diarrhoea, the stools having been green and watery in nature. This diarrhoea was still present on admission. She had lost weight and her appetite was poor.

On Examination

The patient was obviously malnourished and dehydrated. She was lethargic but cooperative. Pigmentation was evident over the exposed portions of her legs and on her face.

The patient was apyrexial; her pulse rate was 50 per minute, and her blood pressure 120/90 mm. Hg. Her tongue was dry. There was mild pallor of the mucous membranes of the oral cavity. On rectal examination a small amount of blood was left on the gloved finger. Her deep reflexes were subnormal. No other abnormal findings were present on physical examination.

Urine. Albumin ++. No other biochemical abnormalities. Microscopic examination: no abnormal findings.

Blood Examinations: Haemoglobin 10 g.%, white cell count: 16,000/c.mm., differential count normal.

Electrolytes: Potassium 1·4 mEq./l., sodium 129 mEq./l., chloride 89 mEq./l., and urea 233 mg.%.

Chest X-ray: Apart from a mild degree of emphysema and an old healed tuberculous process in the left upper lobe, there were no other findings.

ELECTROCARDIOGRAM

The sinus rhythm was 100 per minute, and the P wave was prominent in the standard leads. P–R 0·16 sec.; QRS 0·10 sec., QT not measurable on account of merging of T and U waves. In the

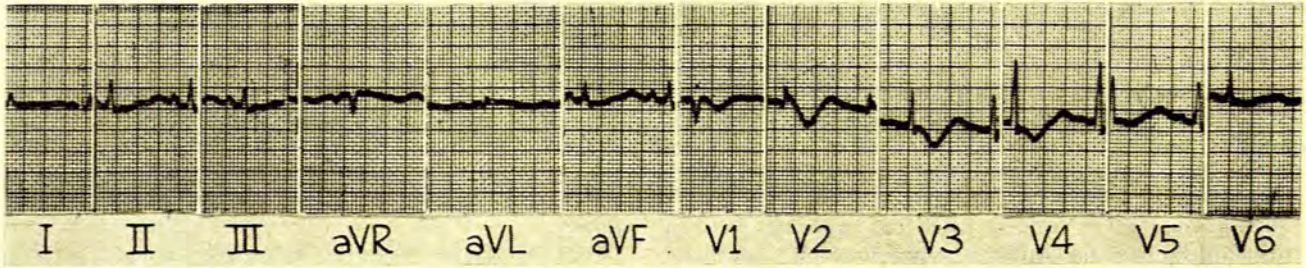

Fig. 1.

ST-segment depression was most marked in V3–V5. T-wave inversion was present in all leads with the exception of aVR, and the U waves were positive and prominent in V2–V6. (Fig. 1).

Diagnosis

The clinical diagnosis was that of severe malnutrition with secondary diarrhoea and vomiting resulting in dehydration with hypopotassaemia. The patient was also in renal failure which might have been the result of prolonged dehydration and hypopotassaemia.

She was treated actively with intravenous fluids and potassium chloride. Her condition failed to respond, however, and she died 3 days after admission.

Permission for an autopsy was obtained and the presence of severe malnutrition was confirmed. There was atrophy of the internal organs. Microscopically the kidneys appeared to have a bilateral cortical necrosis and the histological examination revealed the presence of severe hydropic degeneration of renal tubular epithelium which, together with oedema of the myocardial fibres, were considered to be the result of the hypopotassaemia (Prof. H. W. Weber).

DISCUSSION

The electrocardiographic pattern of hypopotassaemia is dependent on the relationship of the U-wave amplitude to the T-wave amplitude and on displacement of the ST-segment. In the typical pattern the amplitude of the U-wave is increased, the amplitude of the T-wave is decreased or negative, and the ST-segment is depressed. A tracing typical of hypopotassaemia is to be expected if the potassium concentration is below 2·7mEq./l. In patients with plasma-potassium concentrations exceeding 2·7mEq./l. a wide variety of electrocardiographic patterns may be found.[3]

Other electrocardiographic findings which may be present but are not considered directly related to the hypopotassaemia, are an increase in the amplitude of the P-wave and in the amplitude of the QRS complex, and an increase in the duration of P–R interval and of the Q–T interval. Abnormalities in the concentration of serum potassium affect the T-wave and the U-wave in opposite directions. In hyperkalaemia the T-wave tends to be high and pointed and the U-wave small. In hypokalaemia the T-wave is decreased in size or inverted and the U-wave exaggerated. If the U-wave is considered to be the result of an after-potential, then in hypopotassaemia this would mean a negative after-potential. In hypopotassaemia potassium readily leaves the cell during systole and returns slowly, with a resultant large negative after-potential and, presumably, a U-wave.[1]

The prolongation of a Q–T interval is either the result of a Q–U interval mistakenly labelled a Q–T interval, or the result of co-existent hypocalcaemia.[4]

The typical pattern of hypokalaemia may be expected in various clinical conditions such as periodic paroxysmal paralysis, certain cases of chronic nephritis, during a course of treatment of tuberculosis with para-aminosalicylic acid, in Cushing's syndrome, and in prolonged diarrhoea and dysentery. The pattern may develop in cases with intestinal obstruction and prolonged vomiting; it may occur in patients with diabetic coma, especially after treatment with insulin and after infusion of potassium-free physiological saline, and it may also occur in post-operative shock.[2] Patients undergoing therapy with steroid hormones, or those receiving diuretics such as chlorthiazide and similar preparations, may also develop hypopotassaemia. Hypersecretion of primary aldosterone may be an additional cause.

In this patient the diagnosis of hypopotassaemia could be made on the electrocardiographic findings and was subsequently confirmed by biochemical investigations. The condition appears to have been the result of chronic malnutrition with vomiting and diarrhoea. Furthermore, the renal changes which followed and resulted in acute renal failure are of particular interest.

OPSOMMING

Die elektrokardiografiese beeld van hipokalemie kon gedemonstreer word by 'n Kleurlingvrou wat aan 'n chroniese wanvoedingstoestand gely het oor 'n tydperk van 6 maande. Daar was meegaande braking en diaree. Akute nierversaking het gevolg op die toestand, en hidropiese degenerasie van die nefron asook edeem van die hartspier is na nekropsie bevestig. Die elektrokardiografiese kenmerke van hipokalemie bestaan uit 'n verhoging in spanningshoogte van U, met 'n verlaging in dié van die T-uitwyking. Daar is meegaande afwaartse verplasing van ST. Ander bevindings, soos 'n verhoging van die P- en QRS-komplekse, en verlenging van P–R en QT, is nie kenmerkend nie.

REFERENCES

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