Hypokalemia

19

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19.1 Definition

Hypokalemia is defined as a serum potassium of <3.5 mmol/l. It is graded in mild (potassium 3–3.5 mmol/l, whole body deficit 130–300 mmol/l), moderate (potassium 2.5–3.0 mmol/l, whole body deficit 300–500 mmol/l), and severe (potassium <2.5 mmol/l, whole body deficit >500 mmol/l).

19.2 Medical History

Most of the causes of hypokalemia such as severe vomiting, diarrhea, eating disorder, and medication (diuretics, laxative abuse, steroids, cisplatin, etc.) become evident by history. Mild hypokalemia may cause a small elevation of blood pressure and cardiac arrhythmias. Moderate hypokalemia may cause muscular weakness, myalgia, muscle cramps, and constipation. With more severe hypokalemia, flaccid paralysis and hyporeflexia may result. There are reports of rhabdomyolysis and respiratory depression.

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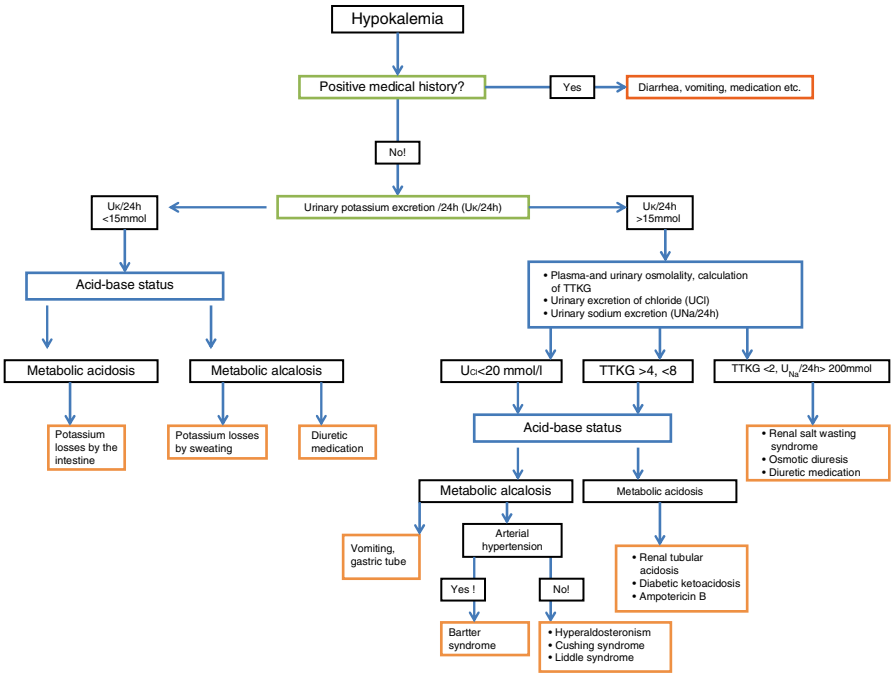

19.3 Diagnostics

Electrocardiographic (ECG) findings associated with hypokalemia include *flattened or inverted T waves*, a U wave, ST depression, and a wide PR interval. Laboratory tests include urinary sodium excretion per day, plasma and urinary osmolality, acid-base status, chloride excretion, and serum sodium.

19.4 Differential Diagnosis

The *trans-tubular potassium gradient* (*TTKG*) is helpful when urinary potassium losses (>15 mmol/24 h) are present; it estimates the ratio of potassium in the lumen of the cortical collecting ducts of the kidney to that in the peritubular capillaries. The following is the formula for calculating the TTKG:

$$\text{TTKG} = \frac{\text{urine}_{\text{K}}}{\text{plasma}_{\text{K}}} \div \frac{\text{urine}_{\text{osm}}}{\text{plasma}_{\text{osm}}}$$

During high potassium intake, more potassium than normal (TTKG 8–9) should be excreted in the urine and the TTKG should be above ten. Low levels (<7) during

hyperkalemia may indicate mineralocorticoid deficiency, especially if accompanied by hyponatremia and high urine Na. During potassium depletion or hypokalemia, the TTKG should fall to less than three, indicating appropriately reduced urinary excretion of potassium (Fig. 19.1).

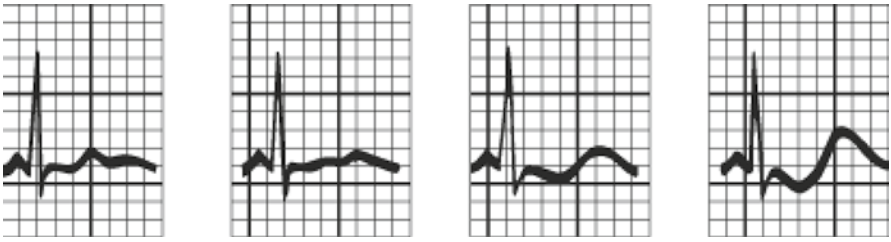

Fig. 19.1 Typical ECG during hypokalemia: *flattened or inverted T waves*, a U wave, and a wide PR interval

Causes of hypokalemia		
Diagnosis	Frequency	Diagnostic measures
Renal losses		
Medication: diuretics, corticosteroids	+++	Medical history, U_K, acid-base status, TTKG
Primary and secondary hyperaldosteronism	+	U_K, TTKG, acid-base status
Osmotic diuresis	+	U_K, TTKG, acid-base status
Enteral losses		
Severe vomiting	+	Medical history, U_K, TTKG, acid-base status, U_{CL}
Chronic diarrhea, laxative abuse	+++	U_K, TTKG, acid-base status
Intracellular shift		
Ileus	++	Medical history, X-ray, and ultrasound of the intestine
Insulin treatment in diabetic ketoacidosis	+	Medical history, U_K, acid-base status, TTKG
Medication: β_2-agonists, theophylline	+	Medical history
Nutritional deficit		
Anorexia nervosa	+	Medical history
Alcoholism	++	Medical history
Rare diseases		
Bartter syndrome	(+)	U_K, TTKG, acid-base status
Liddle syndrome	(+)	U_K, TTKG, acid-base status
Renal tubular acidosis	(+)	U_K, TTKG, acid-base status