Abbreviations:
CCD = cortical collecting duct
TAL = Thick Ascending Limb of the Loop of Henle
TTKG = Trans-Tubular [K+] Gradient
EABV = Effective Arterial Blood Volume

***Hypo*kalemia - DDx**

Low plasma [K+] < 3.5 mmol/L
(Normal [K+] in adults: 3.5-5.1 mmol/L)

↑ Loss

Check urine K+ loss per day
(calculated/estimated from urine [K+] lab reading)

↑ GI Loss

urine K+ lost < 20mmol/day

→Diarrhea
→Vomiting
→Laxatives
→NG-tube drainage

↑ Urinary Loss

urine K+ lost > 20mmol/day

TTKG?

TTKG <4:
Appropriately low K+ excretion, Suggests High filtrate flow, ↑ [Na+] in CCD lumen, ↑ principal cell activity, which ↑ K+ efflux
→Osmotic Diuresis
→Post-obstructive diuresis

TTKG > 4:
Inappropriately High CCD [K+], due to inappropriate principal cell K+ excretion
(more common)

Low EABV

(signs low JVP, postural Hypotension + tachycardia. Hypovolemia = side effect of the following processes/drugs: ↑ aldosterone to retain water, but lose K+

Primary (genetic syndromes)
→Bartter's Syndrome *(Na+ importing channel defect, ↓ Na+ absorption in TAL, mimics loop diuretics, more severe)*
→Gitelman's Syndrome *(similar cause as Bartter's but less severe and more common; mimics thiazide diuretic effect)*

(*Metabolic alkalosis commonly occurs in these pts as a s/e of chronic hypokalemia)*

2^0 (diuretic abuse, low Mg^{2+})
→Loop Diuretics *(prevents Na+ reabsorption, ↑ Na+ in CCD, ↑ K+ secretion by principal cells)*
→Thiazide Diuretics *(same mechanism but less potent)*
→Mg2+ depletion *(triggers more K+ secretion/loss in the TAL, to try to replenish Mg2+)*

Normal/Expanded EABV

(All due to inappropriately high activation of the aldosterone receptor; look @ other clinical clues to make dx)

Low renin, high Aldo:
→1^0 hyperaldosteronism *(associated 2^0 HTN; do CT abdomen and adrenal vein sampling)*

High renin, High Aldo:
→Renal artery stenosis
→Reninoma
(both will cause 2^0 HTN)

Low renin, low Aldo:
→Non-aldosterone mineralocorticoid excess

↓ Intake

(rare)

TTKG?

Transcellular Shift ***Into*** Cells

(Diffusion of K+ from the ECF into the ICF)
TTKG < 4 (appropriately low K+ excretion)
Evaluate the patient's clinical context (medications, active disease processes, etc)

Alkalemia

(Sudden ↑ in base [ ] in ECF → H+ exit cells to neutralize base; Na+ anti-ported into cells. Na+ efflux via NaK-ATPase imports K+ into cell → transient hypokalemia)
→Note: More commonly, it's the hypokalemia that causes the metabolic alkalosis, not the other way around.

↑ Cell Production

(K+ is the main intracellular osmole, so suddenly making new cells consumes K+ from the ECF)
→Acute leukemia
→Correction of Anemia (RBC synthesis)

Stimulation of Na/K-ATPase, which imports K+ into cells

Insulin
(indirectly, via stimulating NHE1)
→Insulin therapy for DKA

Beta-2 agonist
(directly)
→Ventolin for acute asthma exacerbations

Re-feeding syndrome

(↑ nutrients will ↑ new cell synthesis and ↑ insulin → cells ↑ uptake of K+ from ECF → Hypokalemia