Hypokalemia

Nephkids electrolyteworkshop

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DR S.SHANTHI MD.DCH

Former Professor of Pediatrics, ICH&HC,Madras Medical College

Definition

- Severe hypokalemia – Potassium level less than 2.5 mEq/L
- Moderate hypokalemia – Potassium level between 2.5 and 3 mEq/L
- Mild hypokalemia – Potassium level between 3 and 3.5 mEq/L

Etiology

Decreased intake	Increased intracellular uptake	Increased loss-extra renal	Increased loss-renal	Endocrine
• **Severe acute malnutrition**	• **Metabolic alkalosis** • **Insulin** • **Beta adrenergic agents**	• **Diarrhea** • **Emesis** • **Cystic fibrosis**	• **Diuretics** • **DKA** • **Tubulo interstitial disease**	• **Aldosterone-secreting adenomas** • **Glucocorticoid remediable aldosteronism**
• Anorexia	• Heavy metals(barium) • Anti psychotic drugs • Hypokalemic periodic paralysis		• Bartter syndrome • Gitelman syndrome • Renal tubular acidosis • Amphotericin • Liddle syndrome	• Apparent mineralocorticoid excess (AME) • 11-beta-hydroxylase deficiency • 17-alpha-hydroxylase deficiency

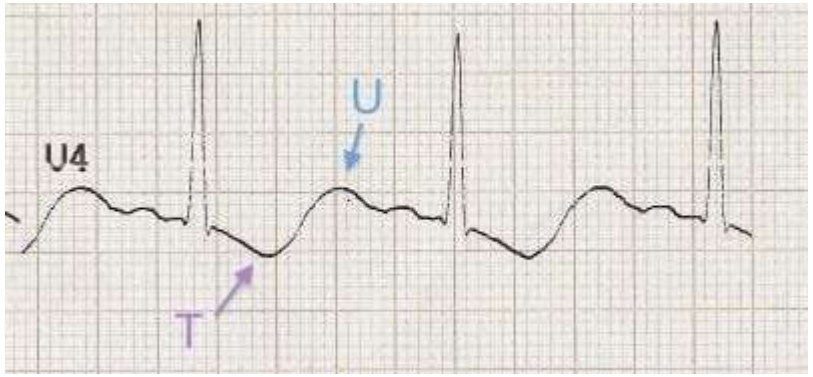
Hypomagnesemia can cause hypokalemia

Clinical features

- Asymptomatic
- Muscle weakness- head lag, hypotonia , ascending paralysis, respiratory failure, death
- Ileus, constipation, abdominal tenderness
- Cramps and fasciculation
- Arrhythmias (more risk with hypomagnesemia)

ECG changes

- PR prolongation
- Flattening of T waves
- ST depression.
- U waves can emerge after the T waves(best seen in the precordial leads V4-V6)

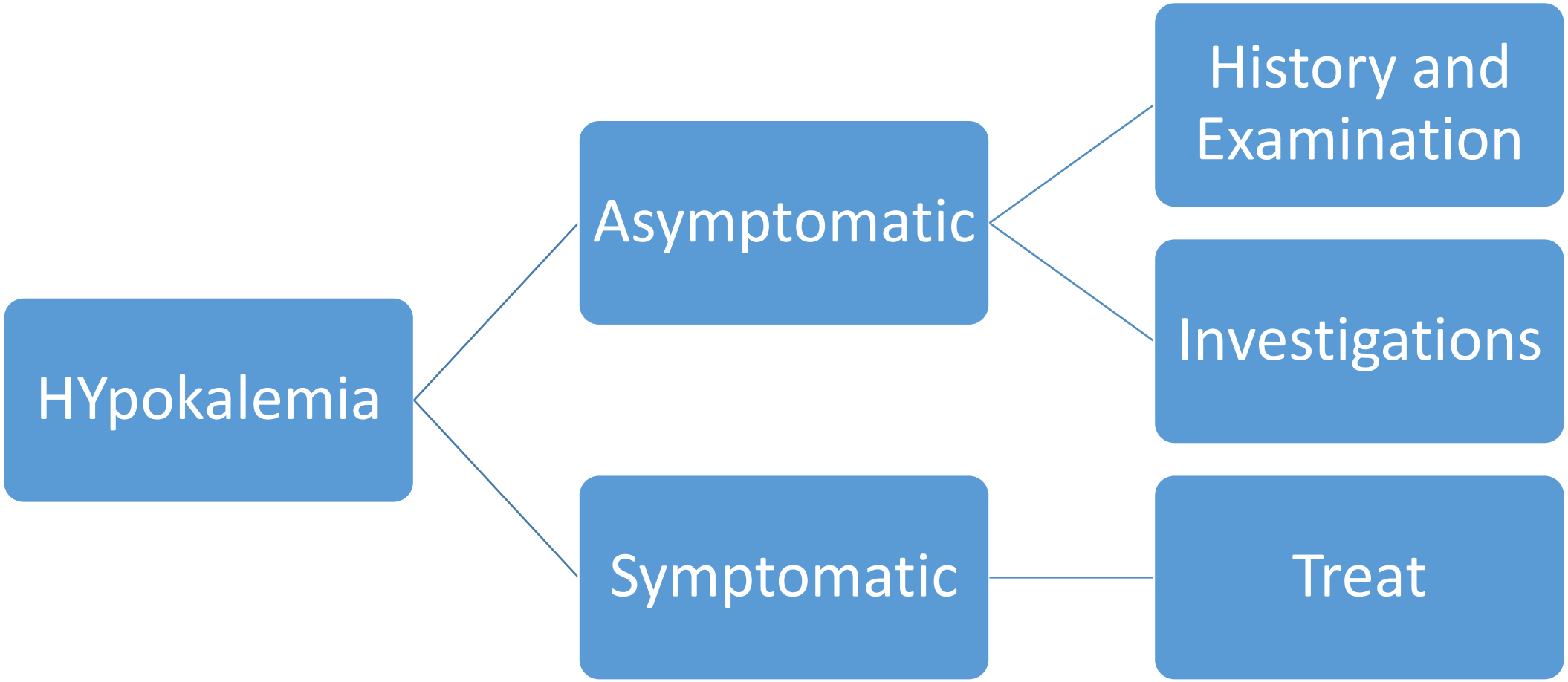


Step -1 Rule out Spurious hypokalemia

- Due to sampling errors - Recent line flush ,IV fluids near sampling site

- It can also occur if the WBC count is very high as in leukemia , if plasma for analysis is left at room temperature where the K is taken up by the cells.

Approach to hypokalemia



Management in symptomatic patients

- Care of ABC
- Fluid boluses may be needed if volume depleted, IV potassium
- 12 lead ECG, continuous cardiac monitoring

Therapeutic goals

- Prevent or treat life-threatening complications
- Correct the potassium deficit
- Address the underlying cause.
- Therapeutic urgency depends on the severity of hypokalemia, the existence of comorbid conditions, and the rate of decline of serum potassium levels

Management in symptomatic patients

- IV in the presence of cardiac dysrhythmias, digitalis toxicity
- KCl IV 0.5 to 1 mEq/kg of body weight per hour under cardiac monitoring.
- The goal is to raise the potassium level by 0.3 to 0.5 mEq/L.
- An infusion with a potassium concentration of no more than 40 -60 mEq/L is given through peripheral line.
- May repeat as needed based on lab values

Caution

- Associated with pain and phlebitis when administered through a peripheral vein
- Do NOT administer undiluted or by IV push. Rapid potassium infusion can cause cardiac arrest.
- Always add K in a new bag
- IV fluids should not contain dextrose as it can stimulate insulin secretion

Monitoring

- Continuous ECG monitoring
- Serum concentrations should be evaluated 1 to 2 hours after completion of infusion and then every 2 to 4 hours untill symptoms resolve
- Watch for rebound hyperkalemia when rates exceed 20 mmol/h or when cellular redistribution is the cause of hypokalemia.[
- Once K normal evaluate

History

- Polyuria, polydipsia (impaired concentrating capacity)
- Loose stools, emesis
- Drug intake
- Renal disease
- Dark urine(rhabdomyolysis, myoglobinuria)
- Symptoms of thyrotoxicosis
- Family history

Physical examination

- HR (bradycardia) and rhythm. Inappropriate low HR in shock
- Blood pressure
- Hypotonia , phantom hernia, head lag, diminished bowel sounds
- Deep tendon reflexes
- Volume status
- Rickets

Hypokalemia etiology based on BP

With hypertension

- Liddle syndrome
- Conn syndrome
- Cushing syndrome
- 11 beta hydroxylase deficiency
- Licorice excess

Without hypertension

- Diuretics
- Diarrhea
- Vomiting
- Bartter syndrome
- Gitelman syndrome
- RTA –I & II

Investigations

- First line : sodium, potassium, chloride, bicarbonate, calcium , magnesium, urea, creatinine, venous blood gas
- Second line: Urine K(Random urinary potassium levels, Spot potassium-to-creatinine ratios,24 hours), TTKG, urinary chloride, USG kidney
- Endocrine : Renin, aldosterone, 17 alpha hydroxylase, 11 beta hydroxylase
- Genetic testing

Hypokalemia based on acid base status

Metabolic acidosis

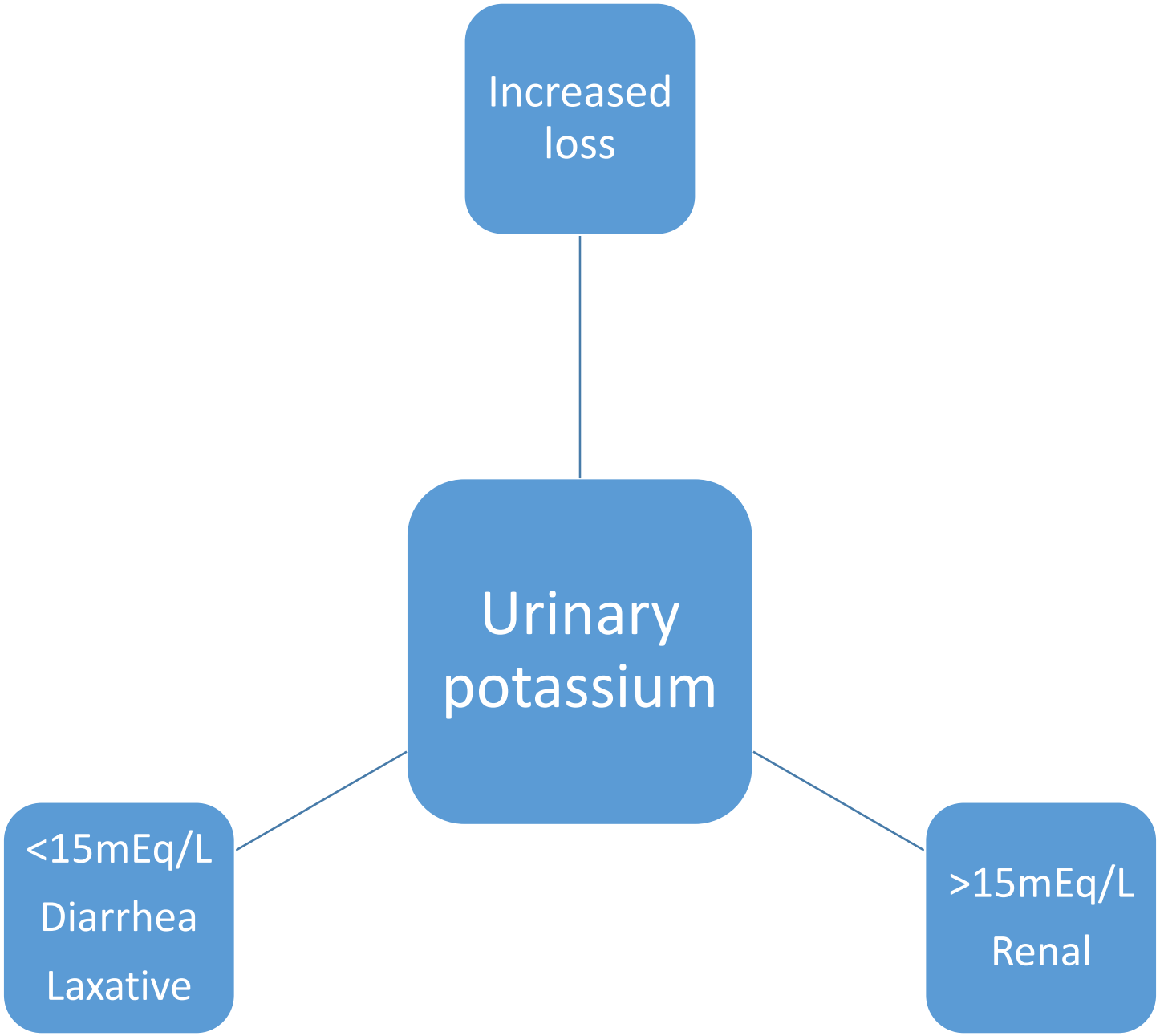
- RTA
- Diarrhea
- DKA

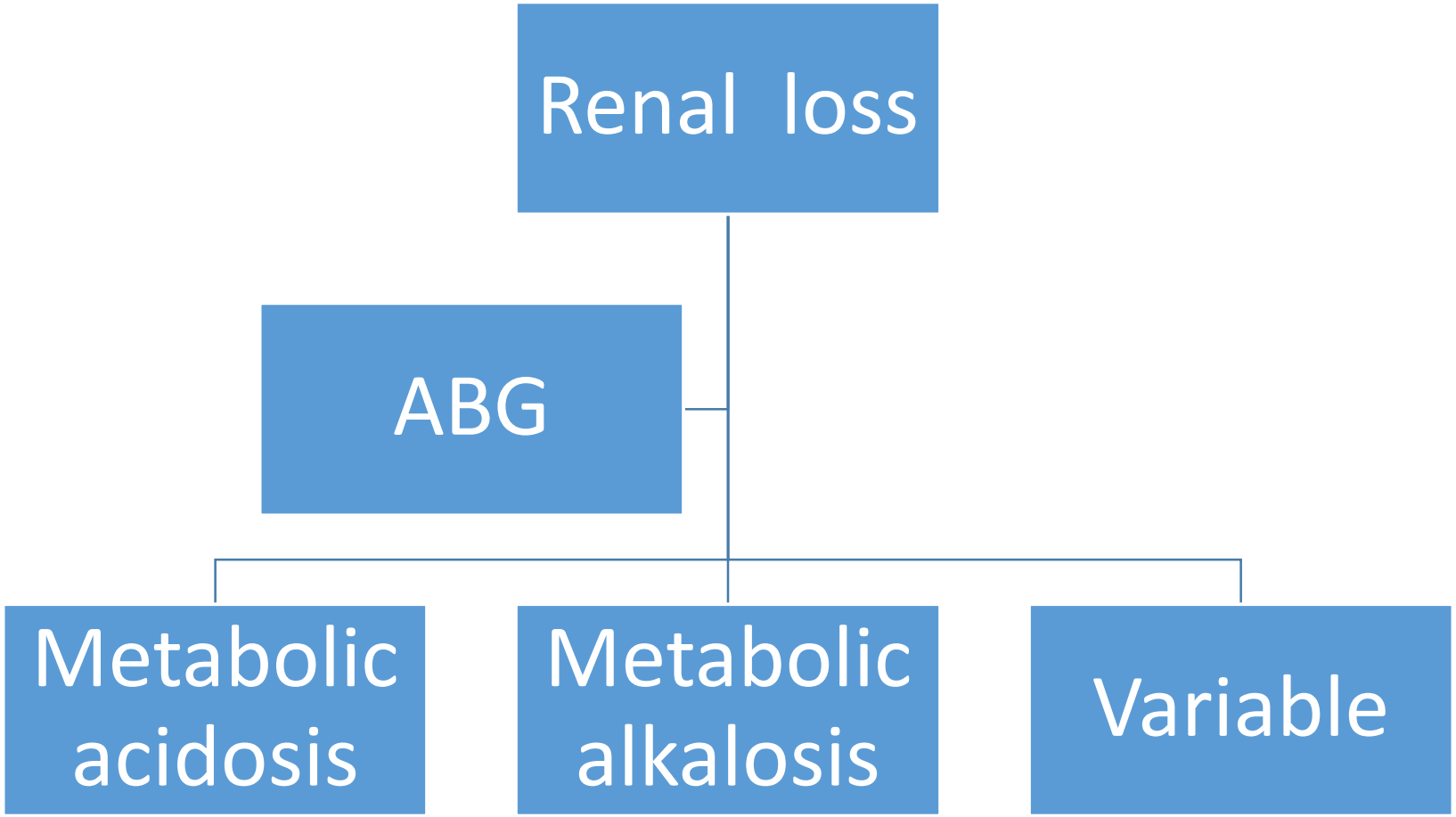
Metabolic alkalosis

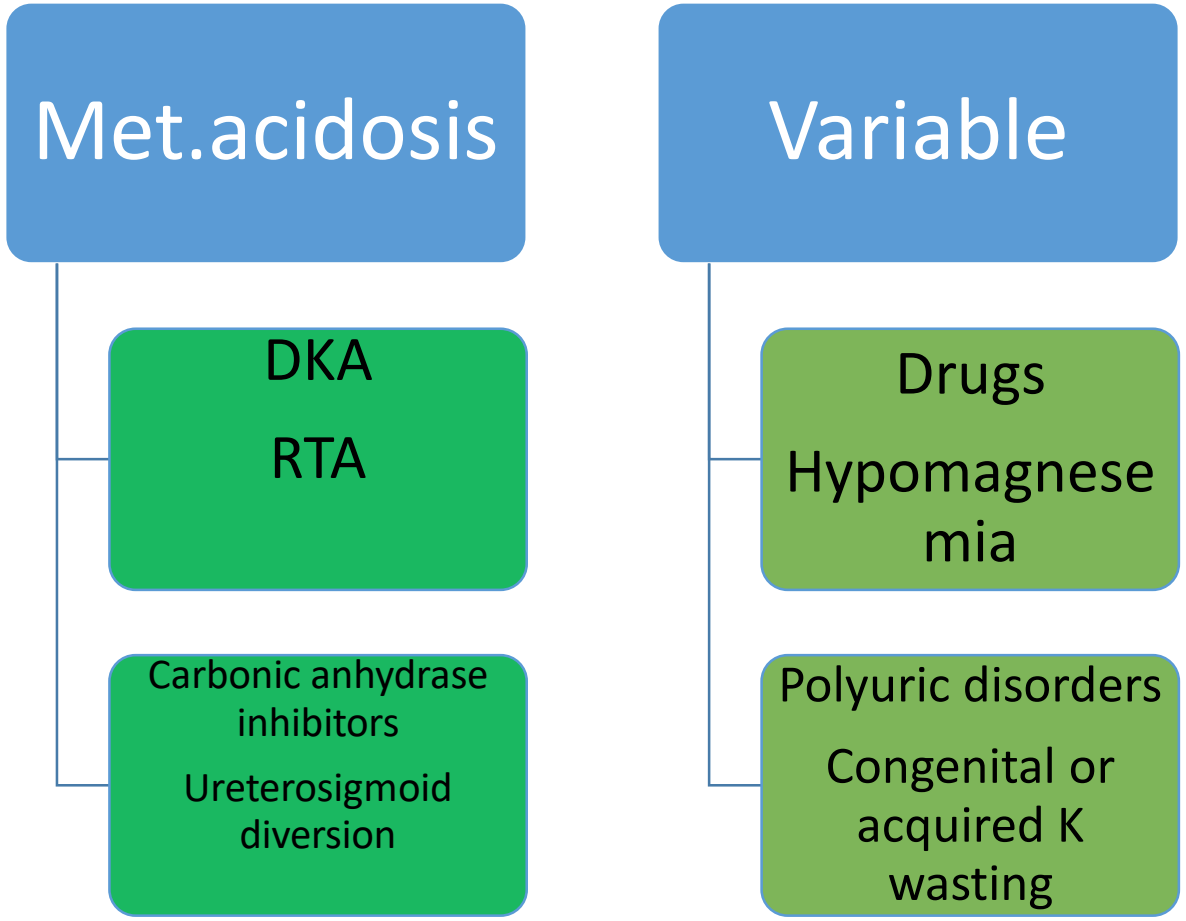
- Conn syndrome
- Vomiting
- Diuretic use
- Heriditary renal channelopathies (Liddle , Gitelman, Bartter syn)

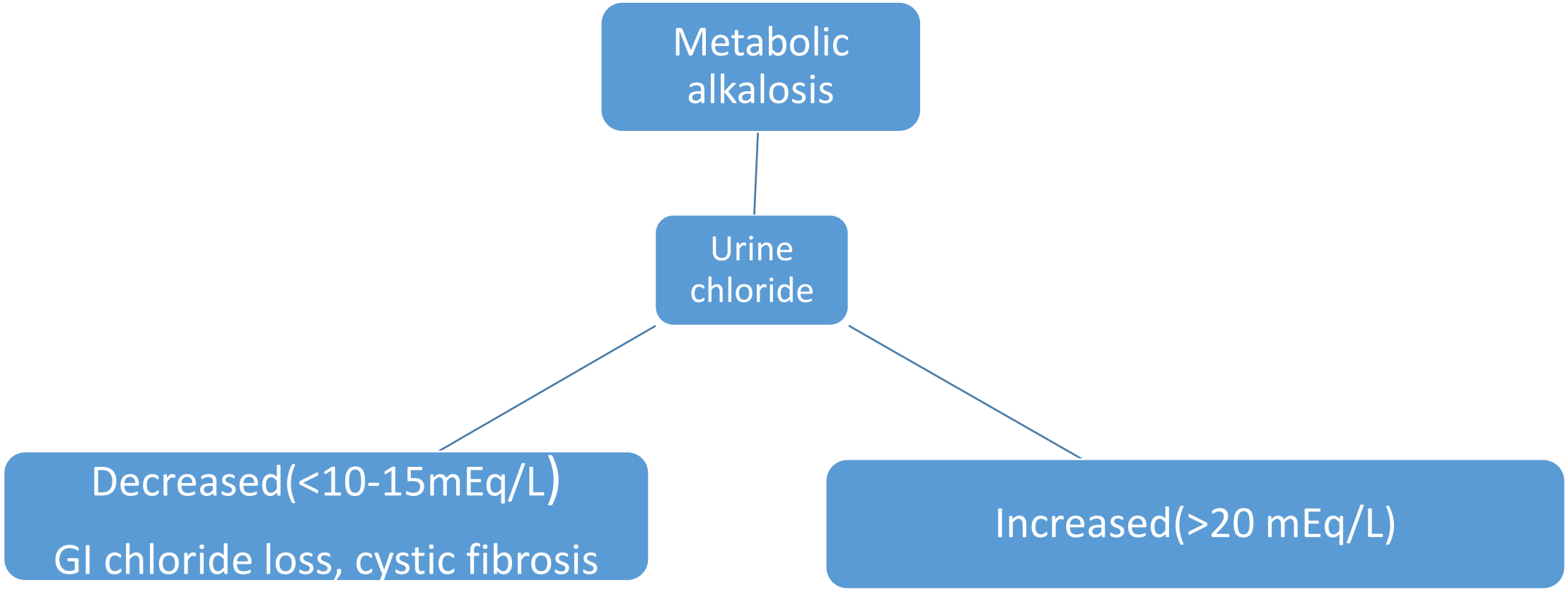
Evaluate

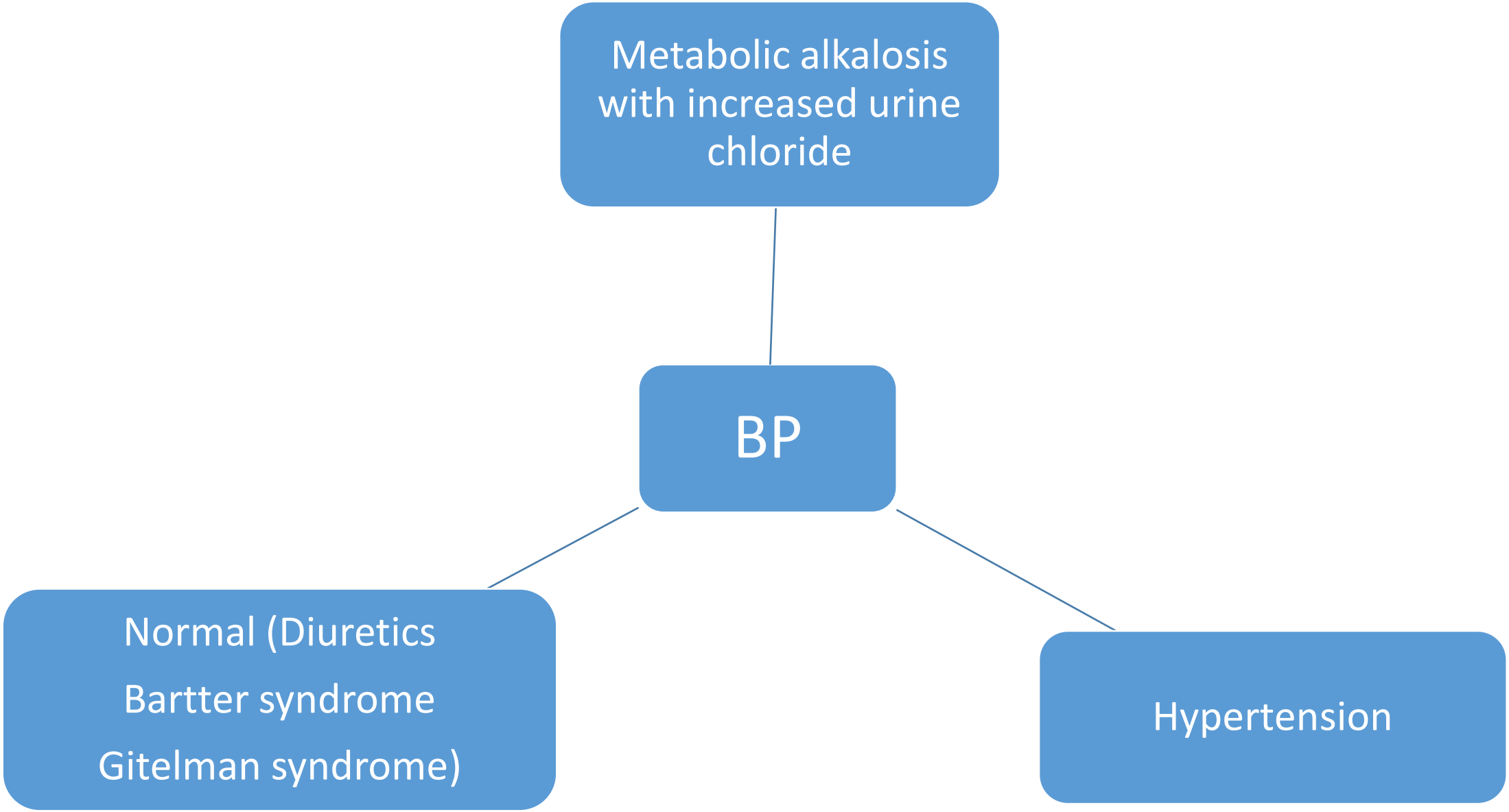
- Decreased intake
- Increased loss
- Transcellular shift

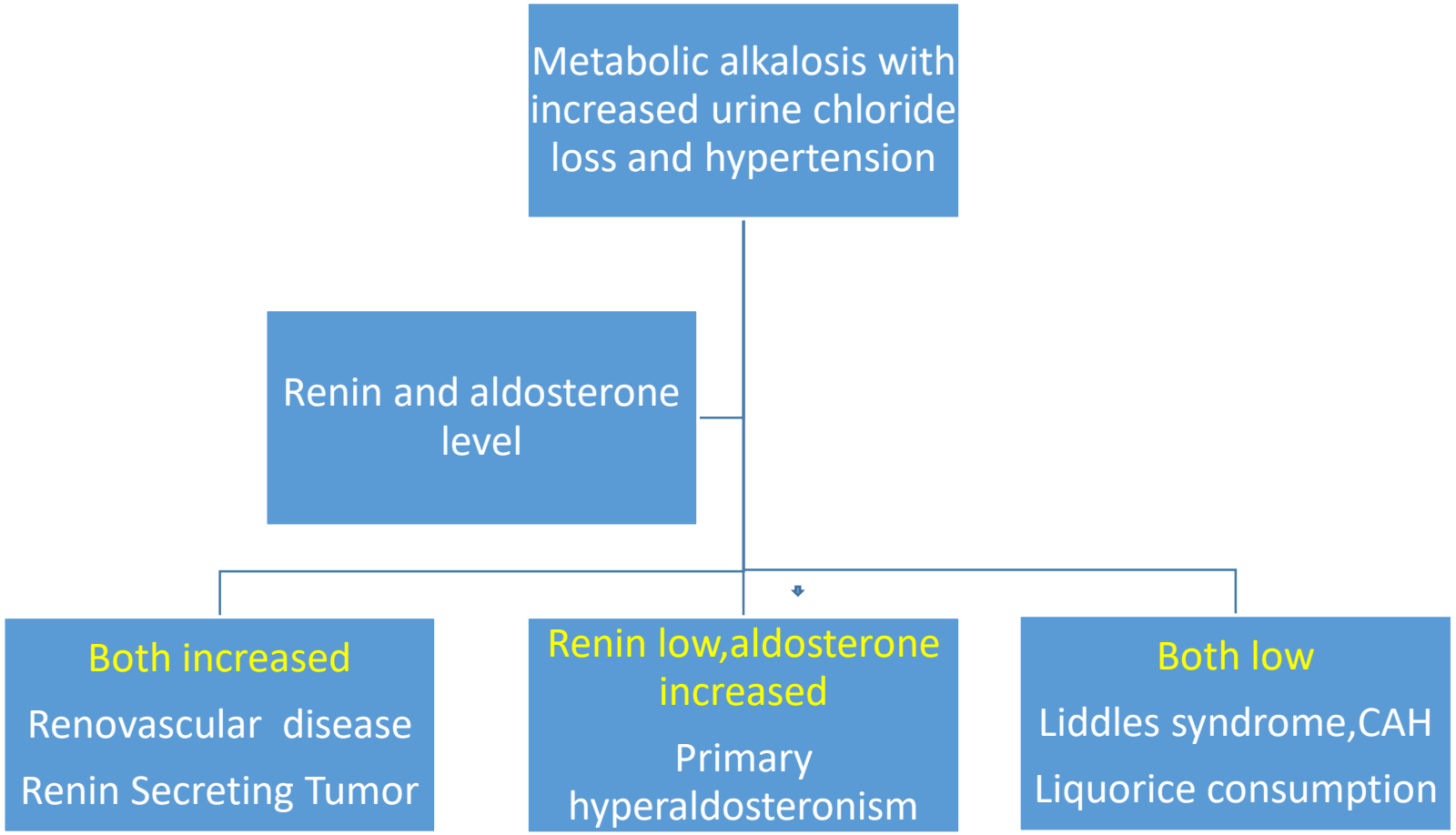

Increased loss
Urinary potassium
<15mEq/L
Diarrhea
Laxative
>15mEq/L
Renal


Renal loss
ABG
Metabolic acidosis
Metabolic alkalosis
Variable


Met.acidosis
DKA
RTA
Carbonic anhydrase inhibitors
Ureterosigmoid diversion
Variable
Drugs
Hypomagnesemia
Polyuric disorders
Congenital or acquired K wasting


Metabolic alkalosis
Urine chloride
Decreased(<10-15mEq/L)
GI chloride loss, cystic fibrosis
Increased(>20 mEq/L)


Metabolic alkalosis with increased urine chloride
BP
Normal (Diuretics
Bartter syndrome
Gitelman syndrome)
Hypertension


Metabolic alkalosis with increased urine chloride loss and hypertension
Renin and aldosterone level
Both increased
Renovascular disease
Renin Secreting Tumor
Renin low,aldosterone increased
Primary hyperaldosteronism
Both low
Liddles syndrome,CAH
Liquorice consumption

Management of asymptomatic patients

3 and 3.5 mEq/L-

- Correction of the underlying cause and dietary potassium
- Maintenance amount of potassium to IV fluids 20mEq/L

Less than 3 mEq/L

- Oral replacement.
- IV only for those who are unable to take oral medications.

In asymptomatic patients with chronic hypokalemia(RTA) potassium supplementation may be needed

Oral potassium

- Potassium chloride, phosphate, acetate, citrate, bicarbonate.
- Initial: 1 to 2 mEq/kg/day in divided doses
- Titrate to desired clinical response
- Usual range: 1 to 5 mEq/kg/day
- Not to exceed 1 to 2 mEq/kg as a single dose up to 40 mEq/dose

Magnesium sulphate

- In hypomagnesemia
- 25-50mg/kg IV over 30 minutes
- Watch for bradycardia, hypotension

Other treatment

- Potassium-sparing diuretic such as amiloride in Bartter, Gitelman

- Hyperaldosteronism - spironolactone or eplerenone