

METABOLIC ALKALOSIS

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IMMEDIATE CONSIDERATIONS

FINDINGS

- **Signs & Symptoms**

- Symptoms are not specific
- Coexistent hypokalemia may cause:
 - Weakness
 - Myalgia
 - Polyuria
 - Cardiac arrhythmias
- Watch for symptoms of hypocalcaemia, like perioral tingling and muscle spasms
- Look for:
 - Vomiting/diarrhea
 - Family history of Bartter syndrome
 - Renal failure
 - Diuretic use
 - Use of glucocorticoids and antacids
 - Previous ileostomy

- **Lab Findings**

- Metabolic alkalosis is diagnosed by measuring serum electrolytes and arterial blood gases.
 - The pH is >7.40 with an elevated bicarbonate concentration
 - A bicarbonate concentration greater than 35 mEq/L is almost always caused by metabolic alkalosis

- Metabolic alkalosis secondary to volume depletion is usually associated with a low urine chloride ion concentration (< 20 mEq/L)

- **Predisposing Conditions/ Classification**

- Check Urine chloride
 - Saline responsive
 - $U_{Cl} < 20$
 - Saline resistant
 - $U_{Cl} > 20$
- Causes of **chloride-responsive** alkalosis (urine chloride < 20 mEq/L) include:
 - Loss of gastric secretions
 - Vomiting
 - Naso-gastric suction
 - Loss of colonic secretions
 - Congenital chloridorrhea
 - Villous adenoma
 - Thiazides and loop diuretics (prior use)
- Causes of **chloride-resistant** alkalosis (urine chloride > 20 mEq/L) **with** hypertension include the following:
 - Primary hyperaldosteronism
 - 11Beta-hydroxylase deficiency
 - Genetic, licorice, chewing tobacco
 - Congenital adrenal hyperplasia
 - 11-Hydroxylase or 17-hydroxylase deficiency
 - Cushing syndrome
 - Exogenous mineralocorticoids or glucocorticoids

- Liddle syndrome
- Renovascular hypertension
- Causes of **chloride-resistant** alkalosis (urine chloride >20 mEq/L) **without** hypertension include:
 - Bartter syndrome
 - Gitelman syndrome
 - Severe potassium depletion
 - Hypomagnesaemia
 - Current use of diuretics in hypertension

DIAGNOSTIC INTERVENTIONS

- **Labs**

- Arterial blood gases
- Serum electrolytes
- Urine chloride
- Calculation of the serum anion gap
 - May help to differentiate between primary metabolic alkalosis and metabolic compensation for respiratory acidosis

- **Monitoring**

- Serial blood gases
- Electrolytes as needed

- **Imaging**

- Depending on etiology

THERAPEUTIC INTERVENTIONS

- **Medications**

- If the patient is on bicarbonate therapy, sodium therapy, or potassium therapy, discontinue all of them
- If the patient is having nausea and vomiting, give **H₂ blockers** or **proton pump inhibitors**
- If this doesn't work:
 - And the patient is hypovolemic without heart failure or cirrhosis, give **isotonic saline**
 - If the patient has heart failure, cirrhosis, or nephrotic syndrome, treat metabolic alkalosis with **diuretics** and **potassium chloride**, in case hypokalemia is presented
- If the patient doesn't respond to isotonic saline, diuretic, or potassium chloride, **dialysis** is indicated

- **Consult**

- Nephrologist

MANAGEMENT AFTER STABILIZATION

- **Follow-Up**

- Serial blood gases
- Electrolytes

- **Further Treatment**

- Both peritoneal dialysis and hemodialysis can be used as long as the dialysate is modified to correct metabolic alkalosis. The main indication of dialysis in metabolic alkalosis is in patients with advanced renal failure, who usually have volume overload and are resistant to acetazolamide
- Management of chloride-resistant metabolic alkalosis is based on the specific cause
 - Primary hyperaldosteronism
 - Use spironolactone, amiloride, or triamterene

- Adrenal adenoma or carcinomas
 - Need surgery
- Glucocorticoid-remediable hyperaldosteronism, metabolic alkalosis, and hypertension
 - Responsive to dexamethasone
- Cushing syndrome
 - Use Potassium-sparing diuretics until surgical therapy is performed
- Bartter syndrome and Gitelman syndrome metabolic alkalosis
 - Can be corrected partially with potassium supplementation, potassium-sparing diuretics, non steroidal anti-inflammatory drugs, or ACE inhibitors
- Liddle syndrome
 - Treat with amiloride or triamterene

CAUTIONS

- **Complications**
 - Severe alkalosis (pH >7.6) can occur
 - May require HCl therapy via a central line and may require dialysis
 - A nephrologist must be involved at this stage

ALGORITHM

- | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| • Measure the arterial pH and bicarbonate. |
| • Check pCO ₂ and determine if the respiratory compensation is adequate. |
| • The pCO ₂ should rise by 0.7 mmHg for every 1 mEq/L rise in bicarbonate. Identify the cause based on urine chloride, blood pressure, plasma renin activity and plasma aldosterone. |

REFERENCES & ACKNOWLEDGMENTS

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