FUROSEMIDE INDUCED HYPOKALEMIA

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ABSTRACT

Hypokalemia is a commonly encountered electrolyte imbalance in clinical practice, affecting up to 21% of hospitalized patients. Diuretic therapy is a major contributor to the development of hypokalemia, with as many as 80% of patients on diuretics at risk of developing this condition. The prevalence of hypokalemia varies between 7% and 56%, depending on the dosage and type of diuretic used. Hypokalemia is a frequent complication associated with diuretic use, especially in populations such as the elderly, women, patients with edematous conditions, and those receiving higher doses or more potent diuretics.

Preventive strategies for hypokalemia include a low-sodium diet supplemented with potassium, magnesium, and chloride, either through potassium-rich foods or potassium chloride supplements. In cases where hypokalemia persists despite these measures, the use of low doses of short-acting diuretics in managing mild to moderate hypertension is advised. In the case presented, the patient developed hypokalemia as a result of furosemide therapy, which was subsequently managed by the addition of potassium supplements.

Keyword: - *hypokalemia, diuretics, furosemide therapy, potassium supplements.*

1. INTRODUCTION: -

Hypokalemia is a commonly encountered condition that has been extensively studied. In most cases, mild hypokalemia remains asymptomatic, whereas moderate-to-severe hypokalemia often presents with more pronounced symptoms. In patients with potassium levels ≤2.5 mEq/L, symptoms such as muscle cramps, weakness, rhabdomyolysis, and myoglobinuria may develop. These manifestations can lead to serious complications, including renal failure secondary to rhabdomyolysis or respiratory failure due to muscle weakness. Additionally, symptoms like ileus, nausea, vomiting, and cardiac arrhythmias may also be observed [(4)]. Factors that increase the incidence and severity of potassium deficiency in patients on diuretics include high-salt diets, large urine volumes, metabolic alkalosis, increased aldosterone production, and the concurrent use of two diuretics acting on different sites in the renal tubule [(10)].

Pericardial effusion refers to the accumulation of excess fluid between the heart and the surrounding pericardial sac. It is a common finding in clinical practice and may present as either an incidental finding or as a manifestation of systemic or cardiac diseases. The causes of pericardial effusion are varied, including infections, malignancies, autoimmune disorders, metabolic conditions, and drug reactions [(13)]. Symptoms of pericardial effusion include shortness of breath, dizziness, fatigue, altered mental status (e.g., confusion or agitation), and swelling in the abdomen and legs. In cases of heart failure (HF) associated with pericardial effusion, treatment typically involves the use of diuretics [(14)].

Diuretics promote renal excretion of sodium and water, which makes them a cornerstone in the management of heart failure. Loop diuretics, such as furosemide and torsemide, are preferred due to their effectiveness and rapid onset of action. Furosemide is typically administered twice daily, while torsemide, being longer-acting, can be prescribed once daily. Although furosemide is not commonly used for hypertension management due to its short duration of action and higher incidence of electrolyte imbalances compared to thiazide diuretics, it is widely used in heart failure treatment [(7)].

2. CASE REPORT: -

A 65-year-old female patient presented to the hospital with complaints of bilateral (B/L) lower limb edema for one week, generalized fatigue for one week, and a non-bloody, whitish cough with expectoration for one week. She has a known history of ischemic heart disease for the past 6 years. On general examination, the patient was found to have B/L pitting edema. A systemic cardiovascular examination revealed a loud second heart sound (P2) in the pulmonary area, which may indicate pericardial effusion (PEff). Vital signs were recorded, showing elevated blood pressure of 165/100 mmHg. Laboratory investigations, including renal and liver profiles and urine analysis, were all within normal limits. A 2D echocardiogram was performed, revealing mild pericardial effusion (ejection fraction = 50%).

Based on both subjective and objective findings, the patient was diagnosed with accelerated hypertension and heart failure with pericardial effusion. The patient was admitted and managed with appropriate diuretics (furosemide), antihypertensives, antiplatelets, proton pump inhibitors (PPIs), mucolytics, and expectorants. On the third day, potassium levels decreased to 2.9 mEq/L from a previous level of 3.6 mEq/L, confirming the hypokalemic effect of furosemide. Potassium supplements were added to the treatment regimen, and subsequent potassium levels were monitored daily, showing a steady increase (3.1, 3.3, 3.5 mEq/L) until reaching the normal range of 3.6 mEq/L. The patient showed symptomatic improvement and was hemodynamically stable, allowing for discharge. The patient's treatment plan is outlined in the table below.

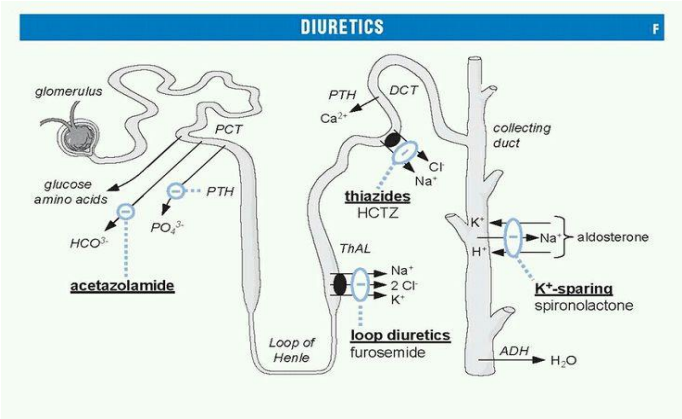
DRUG	DOSE	ROUTE	FREQUENCY	D1	D2	D3	D4	D5	D6	D7
INJ.LASIX	40MG	IV	40-20-0	+	+	+	+	+	+	+
T. RAMIPRIL	2.5MG	PO	1-0-0	+	+	+	+	+	+	+
T. CARVEDILOL	3.125MG	PO	1-0-0	+	+	+	+	+	+	+
T. ECOSPIRIN AV	75/20MG	PO	0-0-1	+	+	+	+	+	+	+
INJ.PAN	40MG	IV	1-0-0	+	+	+	+	+	+	+
SYP.ASCORIL	2TSP	PO	1-1-1	+	+	+	+	+	+	+
T. PULMOCLEAR		PO	1-0-1	+	+	+	+	+	+	+
SYP.POTCLAR	10ML in a glass of water	PO	1-0-0	-	-	+	+	+	+	+
B PROTEIN POWDER	2TSP in a glass of water	PO	1-1-1	-	-	-	+	+	+	+

3. DISCUSSION: -

- Hypokalemia is a condition characterized by lower-than-normal levels of potassium in the blood. Symptoms include muscle cramps, weakness, fatigue, and abnormal heart rhythms. It can result from various medical problems, including kidney or gastrointestinal issues.

- <u>MECHANISM OF LOOP DIURETIC INDUCED HYPOKALEMIA</u>: -

Currently, there are three main types of diuretics that can cause serum potassium depletion: thiazide-type diuretics, which contain a benzothiadiazine molecule; thiazide-like diuretics, which lack this specific structure; and loop diuretics. Loop diuretics act on the thick ascending limb of the renal medullary loop, where they inhibit the active reabsorption of sodium chloride and potassium by blocking the sodium–potassium–chloride cotransporter. This inhibition results in increased sodium reabsorption and excessive potassium excretion in the collecting duct, ultimately leading to potassium depletion [(7)].



- CLASSIFIACTION AND SYMPTOMS OF HYPOKALEMIA: -

Hypokalemia is classified into three categories based on serum potassium levels:
1.mild (3.0–3.5 mmol/L)
2.moderate (2.5–3.0 mmol/L)
3.severe (below 2.5 mmol/L).
In mild cases, clinical symptoms are typically non-specific, including weakness, fatigue, and constipation. In moderate to severe cases, more serious complications may arise, such as rhabdomyolysis and muscle paralysis. When serum potassium levels fall below 2.0 mmol/L or when the reduction is rapid, severe outcomes such as respiratory failure and cardiac arrest may occur.

- TREATMENT: -

1. Reducing Diuretic Dose and Using Potassium Supplementation:
Reducing the dose of diuretics and providing timely potassium supplementation are among the most direct and effective treatments for hypokalemia. The initial dose of potassium chloride supplementation typically ranges from 20–60 mmol/day. It is crucial to maintain serum potassium within the normal range, as both hyperkalemia and hypokalemia can have detrimental effects. Serum potassium levels between 4.1 and 4.4 mmol/L are associated with the lowest mortality risk [(9)].

2. Choice of Diuretics:
The 2018 ESC/ESH and 2020 ISH guidelines give equal importance to thiazide and thiazide-like diuretics, likely due to the widespread use of approved single-pill combinations containing hydrochlorothiazide [(11)]. Indapamide has demonstrated positive cardiovascular outcomes and, when used in its slow-release formulation at a lower dose (1.5 mg instead of 2.5 mg), is associated with a reduced incidence of adverse effects, including hypokalemia.

3. Combination with Other Drugs:
Combining thiazide or thiazide-like diuretics with a potassium-sparing drug is a logical approach to reducing the risk of hypokalemia. Spironolactone, a non-selective mineralocorticoid receptor antagonist (MRA), not only helps mitigate thiazide or loop diuretic-induced hypokalemia and hypomagnesemia but also reduces sodium and water retention by inhibiting aldosterone escape [(7)].

4. CONCLUSIONS

In inpatient settings, healthcare providers typically address the side effects of medications more effectively, as potassium wasting is a common side effect of loop diuretics. However, in outpatient settings, miscommunication can occur, leading patients to take either too much or too little of their medication. Therefore, it is essential to provide clear education on medication adherence to prevent misuse. This is particularly important for patients using furosemide, as although hypokalemia is a well-known side effect of loop diuretics, it can lead to significant electrolyte imbalances if the medication is not taken as prescribed.

The most direct and effective treatments for hypokalemia include reducing the diuretic dose and providing potassium supplementation. Additionally, combining a loop diuretic with a potassium-sparing diuretic or using a renin-angiotensin system blocker can help reduce the risk of hypokalemia. Reducing salt intake and increasing the consumption of fruits and vegetables can not only help lower blood pressure but also prevent hypokalemia.

5. ACKNOWLEDGEMENT

I would like to thank the organization for the support.

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