

EVALUATION OF SERUM ELECTROLYTES AND CARDIAC ABNORMALITIES IN COPD PATIENTS

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ABSTRACT

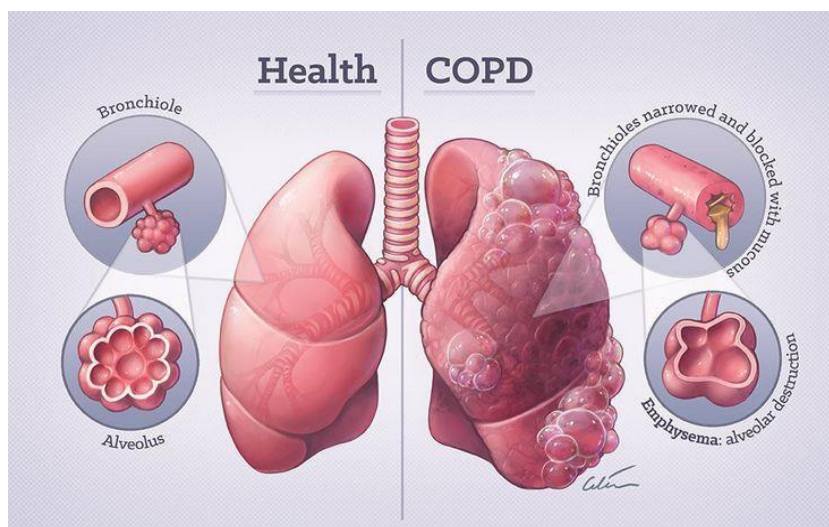
Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation and chronic inflammation. In addition to pulmonary impairment, COPD is associated with systemic complications, including serum electrolyte disturbance and cardiovascular abnormalities, which contribute to increased morbidity and mortality. Hypoxia, hypercapnia, acid-base imbalance, medications, and associated comorbidities can alter serum electrolytes levels and cardiac function. To evaluate serum electrolyte abnormalities and cardiac abnormalities in patients with COPD and to assess the relationship between electrolyte imbalance and electrocardiographic (ECG) findings. This observational study included diagnosed COPD patients attending the outpatient and inpatient departments of a tertiary care hospital. Clinical history, physical examination, serum

electrolytes levels (sodium, potassium, chloride, calcium, and magnesium), and ECG findings were recorded and analyzed. Statistical methods were used to determine the prevalence of electrolytes abnormalities and their association with cardiac abnormalities. The study demonstrated that electrolyte disturbances, particularly hyponatremia and hypokalemia, were common among COPD patients. ECG abnormalities such as sinus tachycardia, right axis deviation, right ventricular hypertrophy, P pulmonale, and arrhythmias were also frequently observed. A significant association was found between electrolyte imbalance and the occurrence of cardiac abnormalities, especially in patients with severe COPD and acute

exacerbations. Serum electrolyte disturbances and cardiac abnormalities are common in COPD patients and may worsen disease prognosis. Regular monitoring of electrolyte levels and ECG changes is essential for the early detection and appropriate management of these complications, which may improve patient outcome and reduce morbidity.

KEYWORDS: COPD, serum electrolytes, hyponatremia, hypokalemia, electrocardiography (ECG), cardiac abnormalities, arrhythmias, right ventricular hypertrophy.

INTRODUCTION



Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation, which is not fully reversible and is accompanied by chronic respiratory symptoms. Globally, COPD remains a leading cause of morbidity and mortality, responsible for approximately 3.23 million deaths in 2019, making it the third leading cause of death worldwide.^[1] The disease not only impairs pulmonary function but is also frequently complicated by comorbid systemic disturbances, including cardiac abnormalities and significant metabolic derangements such as serum electrolyte imbalances.^[2,3]

Electrolyte disturbances, particularly during acute exacerbations of COPD (AECOPD), are widely reported and are associated with poorer clinical outcomes. Hyponatremia, hypokalaemia, and hypomagnesemia are the most frequent electrolyte imbalances observed in these patients.^[4,5,6,7] The underlying mechanisms are multifactorial, involving use of diuretics, hypoxia, respiratory acidosis, hormonal derangements, and altered renal function. Studies consistently report that these abnormalities are more prevalent and severe during acute

exacerbations compared to stable COPD and healthy controls.^[1,5,8]

These derangements can compound respiratory compromise, induce muscle weakness, and increase the risk of life-threatening cardiac arrhythmias⁸ Adverse effects of chronic hypoxemia and acid-base disturbances on cardiac electrophysiology and structural integrity.^[2,3,9]

Acute exacerbations of COPD further raise the risk of cardiac dysrhythmias, particularly atrial fibrillation and multifocal atrial tachycardia, both of which worsen prognosis and increase hospital stays and mortality rates. The prevalence of arrhythmias in patients hospitalized with COPD exacerbations has been observed at 20–30%, highlighting the need for cardiovascular assessment in management strategies.^[9]

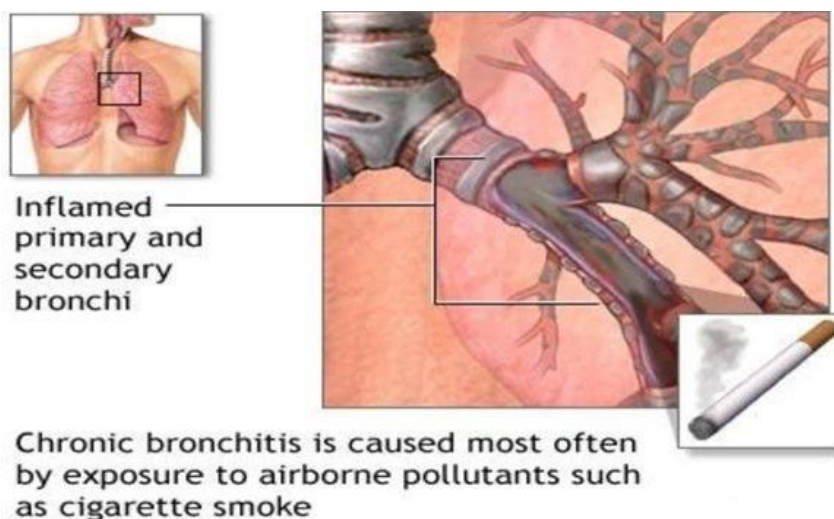
Rationale for the Study: Given the strong associations between serum electrolyte imbalances, cardiac complications, and adverse outcomes in COPD, systematic evaluation of these parameters is crucial in clinical practice. Disturbances in serum sodium, potassium, calcium, and magnesium not only influence respiratory and neuromuscular function but can precipitate fatal arrhythmias and contribute to overall cardiovascular burden in these patients. Early detection and correction of these abnormalities may significantly improve the prognosis and quality of life of COPD path.

Chronic Obstructive Pulmonary Disease is a chronic, progressive lung disease characterized by persistent airflow limitation that is not fully reversible. It causes breathing difficulty due to airway inflammation and damage to the lungs, most commonly from long-term exposure to cigarette smoke or other harmful particles and gases.^[16,17,18,19,20]

TYPES OF COPD

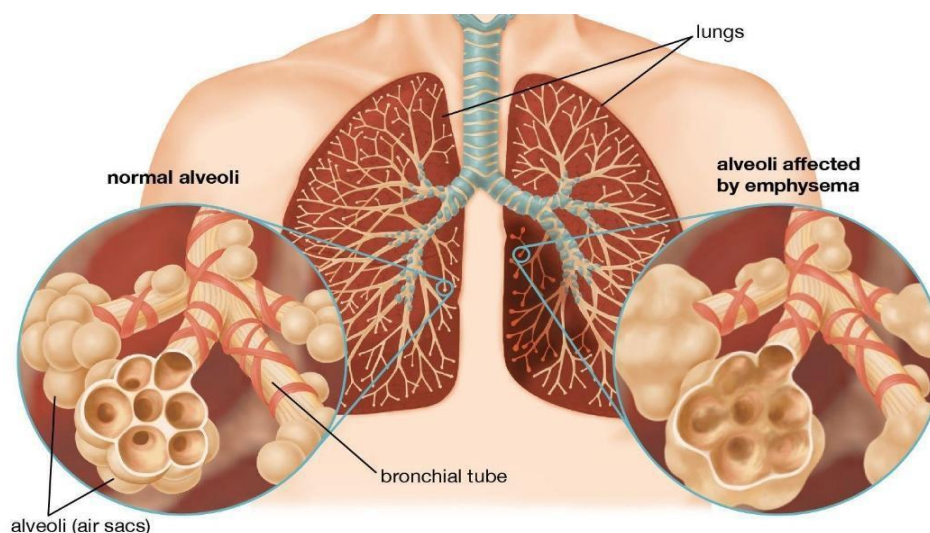
1. CHRONIC BRONCHITIS^[16,17]

- Defined as a productive cough lasting for at least 3 months in each of 2 consecutive years.
- Characterized by inflammation of the bronchi and excessive mucus production.
- Common symptoms:
 1. Chronic cough
 2. Sputum production
 3. Wheezing
 4. Shortness of breath



2. EMPYSEMA^[16,17,18]

- Characterized by destruction of the alveoli (air sacs), reducing the surface area available for gas exchange.
- Leads to loss of lung elasticity and air trapping.
- Common symptoms:
 1. Dyspnea
 2. Chronic cough
 3. Wheezing
 4. Chest tightness



MATERIALAND METHODS

STUDY AREA: The study will be conducted in the Department of pulmonary medicine BRIMS GOVERNMENT GENERAL HOSPITAL, BIDAR.

STUDY POPULATION: The study population includes patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) attending the outpatient department or admitted to the medical wards of the hospital.

STUDY DESIGN: This is a hospital based.

METHODOLOGY

Cardiac abnormalities will be correlated with the COPD severity grade to understand Patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) based on clinical features and confirmed by spirometry as per the GOLD (Global Initiative for Chronic Obstructive Lung Disease) guidelines will be included in the study. Eligible participants will be selected from those attending the outpatient department or admitted to the medical wards during the study period.

All patients who fulfil the inclusion criteria and provide informed written consent will be enrolled. Venous blood samples will be collected from all patients under strict aseptic precautions. These samples will be analysed for serum electrolytes including sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), and magnesium (Mg^{2+}). All biochemical estimations will be performed in the central laboratory using a fully automated analyser, and standard operating procedures will be followed to ensure accuracy and reliability of results.

In addition to laboratory investigations, all patients will undergo a 12-lead electrocardiogram (ECG) to identify cardiac rhythm abnormalities such as arrhythmias, right axis deviation, P pulmonale, or signs of right ventricular hypertrophy.

CASE STUDY

1. PATIENT DETAILS

- **NAME** – MOHAMMED CHAN (INPATIENT)
- **AGE** – 74
- **SEX**- male
- **WEIGHT**- 81 kg
- **CONSULTANT**- Dr. Satish mudbi
- **DEPARTMENT**- pulmonary medicines

PHYSICAL EXAMINATION

- **BLOOD PRESSURE**- 140/90mmhg
- **BODY TEMPERATURE**- 98.6°F
- **PULSE RATE**- 103/min
- **OXYGEN SATURATION**- 92%
- **RESPIRATORY RATE**- 22/min

CHIEF COMPLAINTS

- Shortness of Breathing (dyspnoea)
- Sputum production
- Cough
- Fatigue

PERSONAL HISTORY

- Smoker since 30 years
- Alcohol consumption
- Mixed diet

PAST MEDICAL HISTORY

- Hypertension
- Diabetics
- Previous hospitalization (Osmania general hospital Hyderabad)

INVESTIGATION

- COMPLETE BLOOD TEST
- SERUM ELECTROLYTE PROFILE
- ECG
- OXYGEN SATURATION

COMPLETE BLOOD TEST

DEPARTMENT OF HAEMATOLOGY

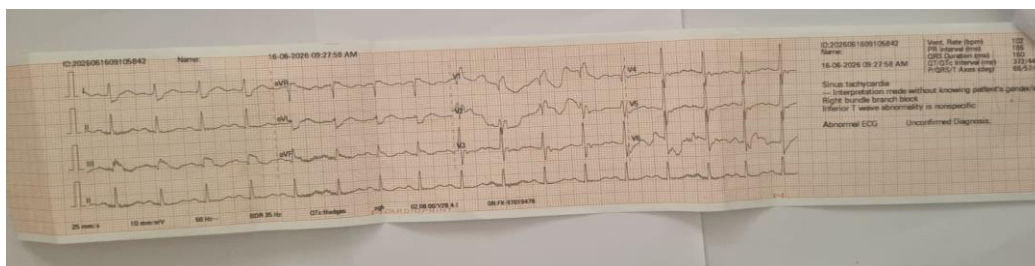
TEST	RESULT	UNITS	NORMAL RANGE
Haemoglobin	9.5	gms %	13.0-18.0
W.B.C count	9,600	cells/mm ³	5,000 – 10,000

DIFFERENTIAL COUNT

Neutrophils	50	%	40-70
Lymphocytes	45	%	20-45
Eosinophiles	03	%	00-04
Monocytes	02	%	00-05
Basophiles	00	%	00-02
R.B.C count	4.52	millions/mm ³	4.5-6.5
Platelet count	4.27	lacs/mm ³	1.5-4.5
P.C.V	34.1	%	42-52
M.C.V	75.4	Fl	82-92
M.C.H	21.0	pg	27-32
M.C.H.C	27.9	%	32-36
BLEEDING TIME	2min15sec		01-05min
CLOTTING TIME	6min45sec		05-12min
BLOOD GROUP	"A"		
RH TYPE	POSITIVE		

SERUM ELECTROLYTE PROFILE

TEST	RESULT	UNITS	NORMAL RANG
Sodium	130	mmol/l	135-145
Potassium	3.2	mmol/l	3.50-5.10
Chloride	95	mmol/l	98-103
Calcium	8.2	mg/dl	8.6-10.3
ECG			



OXYGEN SATURATION



2. PATIENT DETAILS

- **NAME** - Mr. ISMAIL (OUTPATIENT)
- **AGE** – 64
- **SEX** – Male
- **WEIGHT** – 52Kg
- **CONSULTANT** – Dr. Satish Mudbi
- **DEPARTMENT** – pulmonary medicines

PHYSICAL EXAMINATION

- **BLOOD PRESSURE** – 120/80mmHg
- **BODY TEMPERATURE** – 98.6°F
- **PULSE RATE** – 75/min
- **OXYGEN SATURATION** – 95%
- **RESPIRATORY RATE** – 15/min

CHIEF COMPLAINTS

- Shortness of breathing (dyspnoea)
- Cough
- Sputum production
- Fatigue and weakness

PERSONAL HISTORY

- Smoker Since 22 years
- Mixed diet

PAST MEDICAL HISTORY

- NIL

INVESTIGATION

- Blood test
- ECG
- Oxygen saturation
- Serum electrolytes

COMPLETE BLOOD TEST**DEPARTMENT OF HAEMATOLOGY**

TEST	RESULT	UNIT	NORMAL RANGE
Haemoglobin	10	gms %	13-18
W.B.C	6500	cells/mm ³	5,000-10,000

DIFFERENTIAL COUNT

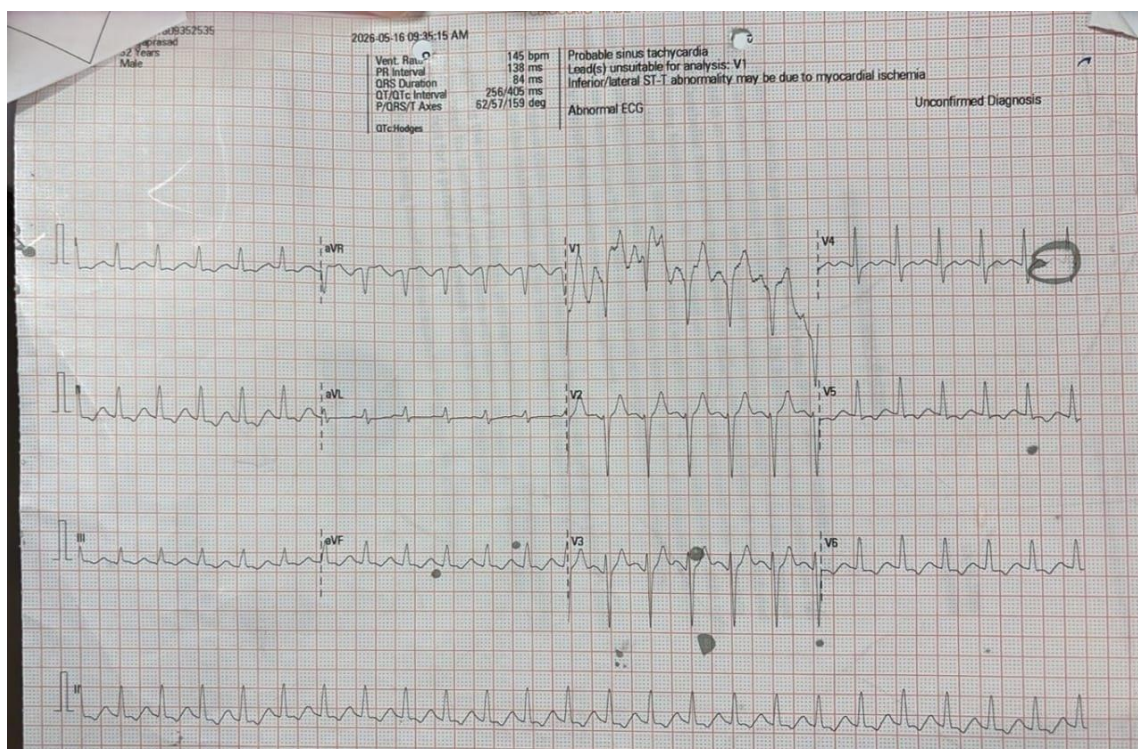
Neutrophils	48.70	%	40-70
Lymphocytes	40.40	%	22-45
Eosinophils	04.50	%	01-06
Monocytes	05.40	%	02-10
Basophils	01.00	%	00-02
R.B.C count	04.08	millions/mm ³	4.5-6.5
Platelet count	02.08	lacs/mm ³	1.5-4.0
P.C.V	48	%	42-52
M.C.V	88.80	Fl	82-92
M.C.H	30	pg	27-32
M.C.H.C	34.30	g/dl	32-36
BLEADING TIME	2min3sec		1min-5min
CLOTTING TIME	6min		5min-12min

BLOOD GROUP**“AB”****RH TYPE****POSITIVE****SERUM ELECTROLYTES**

TEST	RESULT	UNITS	NORMAL RANGE
Calcium	8.10	mg/dl	8.6-10.3
Sodium	134.07	mEq/l	135-145
Potassium	3.40	mEq/l	3.50-5.10
Chloride	97.92	mEq/l	98-107

OXYGEN SATURATION

ECG



RESULT AND DISCUSSION

RESULT

A total of two patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) were included in this study. The demographic characteristics revealed that both patients belonged to the elderly age group (above 60 years), which is consistent with the increased prevalence of COPD among older individuals due to cumulative exposure to risk factors and age-related decline in lung function. One or both patients had a history of cigarette smoking and/or prolonged exposure to biomass fuel, which are recognized as the major etiological factors for COPD.

Clinical evaluation showed that both patients had moderate to severe airflow limitation with symptoms such as chronic cough, sputum production, dyspnoea, and reduced exercise tolerance. One patient presented during an acute exacerbation, while the other had stable COPD with chronic symptoms.

Serum Electrolyte Findings

Serum electrolyte analysis demonstrated abnormalities in one or both patients. The most commonly observed electrolyte disturbances included hyponatremia, hypokalaemia, hypocalcaemia, and hypomagnesaemia.

Hyponatremia was the most frequent abnormality and was associated with chronic hypoxia, increased antidiuretic hormone secretion, and diuretic therapy. Hypokalaemia was observed in patients receiving β_2 -agonists, corticosteroids, or diuretics, all of which can increase potassium loss.

Hypocalcaemia and hypomagnesemia were also detected, possibly due to poor nutritional status, inadequate dietary intake, renal electrolyte loss, and prolonged corticosteroid use.

The severity of electrolyte imbalance appeared to correlate with the severity of COPD and was more pronounced during acute exacerbations.

Electrocardiographic (ECG) Findings

Electrocardiographic evaluation revealed several cardiac abnormalities. The most common findings included sinus tachycardia, which reflected the physiological response to chronic hypoxemia. Other abnormalities included premature atrial contractions (PACS), premature ventricular contractions (PVCs), atrial fibrillation, right ventricular hypertrophy (RVH), and evidence of right heart strain.

Patients with severe airflow limitation and longer disease duration showed more pronounced ECG abnormalities. These findings suggest that chronic pulmonary disease significantly affects cardiac function and increases the risk of arrhythmias.

DISCUSSION

The present study evaluated serum electrolyte abnormalities and electrocardiographic changes in patients with Chronic Obstructive Pulmonary Disease (COPD). The findings indicate that electrolyte disturbances and cardiac abnormalities are common in COPD patients and become increasingly frequent with disease progression and acute exacerbations.

The observed electrolyte disturbances are consistent with previous studies reporting that chronic hypoxia, hypercapnia, medications, and systemic inflammation contribute to altered electrolyte homeostasis. Hyponatremia is often caused by Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH), chronic hypoxia, and excessive fluid retention. Hyponatremia has been associated with prolonged hospitalization, increased and poor prognosis. disease severity, Hypokalaemia is commonly seen in COPD patients receiving β_2 -agonists and loop diuretics. Reduced potassium levels increase myocardial excitability, thereby predisposing patients to cardiac arrhythmias. Similarly, hypomagnesemia further increases

the risk of ventricular arrhythmias and may worsen hypokalaemia by impairing potassium reabsorption.

Hypocalcaemia observed in COPD patients may result from vitamin D deficiency, malnutrition, corticosteroid therapy, or chronic illness. Low calcium levels contribute to impaired neuromuscular function and may influence myocardial contractility.

ECG abnormalities observed in this study are attributable to chronic hypoxemia, pulmonary hypertension, and increased right ventricular workload. Persistent hypoxia causes pulmonary vasoconstriction, leading to pulmonary hypertension and eventually cor pulmonale. These structural and functional cardiac changes predispose COPD patients to arrhythmias such as atrial fibrillation and ventricular ectopic beats.

Sinus tachycardia was the most frequent ECG finding because it represents a compensatory mechanism to maintain oxygen delivery during hypoxia. However, persistent tachycardia increases myocardial oxygen demand and may worsen cardiac function in patients with underlying cardiovascular disease.

The association between electrolyte imbalance and ECG abnormalities observed in this study highlights the importance of routine laboratory investigations and electrocardiographic monitoring in COPD patients. Early recognition and correction of electrolyte disturbances can reduce the occurrence of life-threatening arrhythmias, improve treatment outcomes, and decrease hospital admissions.

Although the present study included only two patients, the findings demonstrate a clear relationship between COPD severity, electrolyte disturbances, and cardiac abnormalities. Larger studies with a greater sample size are recommended to validate these observations and establish stronger statistical significance.

CONCLUSION

The present study concludes that serum electrolyte abnormalities and electrocardiographic changes are common complications in COPD patients, particularly during acute exacerbations and advanced stages of the disease. Hyponatremia, hypokalaemia, hypocalcaemia, and hypomagnesemia were the most frequently observed electrolyte disturbances, while sinus tachycardia and other cardiac arrhythmias were the predominant ECG abnormalities.

Routine monitoring of serum electrolytes and ECG should be incorporated into the standard management of COPD patients to facilitate early detection of complications, reduce cardiovascular morbidity, improve therapeutic outcomes, and enhance patients' quality of life.

KEY IMPLICATIONS

- Routine assessment of serum electrolytes should be performed in all hospitalized COPD patients.
- ECG should be included as a standard investigation, especially during acute exacerbations.
- Early correction of electrolyte abnormalities may reduce the incidence of cardiac arrhythmias.
- Appropriate use of bronchodilators, corticosteroids, and diuretics should be accompanied by electrolyte monitoring.
- Early diagnosis and management of cardiac abnormalities can improve patient prognosis.
- A multidisciplinary approach involving pulmonologists, physicians, cardiologists, and clinical pharmacists is essential for comprehensive COPD care.
- Larger prospective studies are needed to further evaluate the relationship between electrolyte imbalance and cardiac abnormalities in COPD patients.

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