A Prospective Observational Study on Correlation between Serum Electrolytes and Cardiovascular Patients' Recovery Rate

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Abstract

The objective of this study is to evaluate how inadequate medication adherence, electrolyte imbalances, and other factors affect the state of recovery for patients with cardiovascular disease (CVD). Analyzing the frequency and kinds of electrolyte imbalances, assessing medication adherence, and figuring out how these variables relate to recovery rates are some of the particular goals. Given the continued global increase in cardiovascular disorders, it is essential to comprehend the factors that influence patient recovery. Although electrolyte imbalances can be fatal, they are frequently avoidable. The study emphasizes how important Serum electrolytes are for heart function, and how aberrant serum potassium (Sr. K^+) levels have a major effect on heart contractility. Individuals with normal or borderline serum electrolytes recovered more quickly than those with abnormal levels. Recovery rates were also significantly influenced by comorbidities, medication adherence, social routines, and food patterns. In conclusion, anomalies in serum potassium, especially hypokalemia, have a significant impact on cardiac patients recovery. Improving overall patient outcomes and maximizing recovery in CVD therapy requires the effective management of these electrolyte imbalances, as well as comorbidities, dietary and social practices, and drug adherence.

Keywords: CVD patients, Serum electrolytes, Hypokalemia, Medication adherence, Social habits, Recovery rate.

Introduction:

Thirty to fifty percent of instances of cardiovascular disease (CVD) are coronary artery disease, which affects the heart and blood arteries. The main cause of death worldwide is CVD (17.7 million in 2015). In addition to non-modifiable factors (family history, age, gender), risk also rises with age and is impacted by modifiable factors (smoking, inactivity, poor diet, hypertension, diabetes, obesity, stress, and alcohol). Conditions require different approaches to management, but lifestyle changes are essential for prevention (1).

Electrolyte Imbalance in Cardiovascular Disease

Electrolytes like sodium (Na^+), potassium (K^+), and chlorine (Cl^-) are essential for preserving the electrophysiological characteristics of muscle and nerve cells as well as cellular membrane potentials. Early diagnosis of electrolyte abnormalities is crucial for controlling and preventing problems in patients with cardiovascular disease (CVD), since imbalances in these electrolytes can lead to serious cardiac events (2). Patient care and results can be greatly improved by being aware of these imbalances.

Elevated cardiovascular morbidity and mortality have been linked to changes in serum electrolyte levels (3).

The main cause of sudden cardiac death within an hour of CVD is changes in myocytes and Purkinje fibers, which are impacted by autonomic activity and electrolyte abnormalities. Close monitoring of electrolyte balance is necessary for patients who are more likely to experience deadly arrhythmias (4).

Sodium Imbalance:

The most prevalent electrolyte imbalance among hospitalized patients is hyponatremia, or insufficient sodium, which is a sign of an acute myocardial infarction. In around 10% of people with heart failure, it is independently linked to atrial fibrillation. Sodium levels are useful prognostic indicators as they may signify clinical improvement when they begin to rise after first declining. These anomalies frequently indicate the severity of the illness and lead to a poor prognosis over a prolonged period (5).
Therefore, it does not directly contribute to death, but rather reflects the severity of the underlying disease (6).

However, it is unclear if the greater mortality in CVD patients with electrolyte abnormalities is attributable to the imbalance itself or an underlying serious heart disease with a poor prognosis (7).

Potassium Imbalance:

Heart arrhythmias can be caused by hypokalemia, or low potassium, particularly in patients who already have heart diseases like ischemic heart disease and left ventricular hypertrophy. In addition, it results in hyperglycemia, rhabdomyolysis, muscle weakness, and renal failure. In critical care units, potassium levels are closely observed due to these risks, especially for patients with cardiovascular disease (8).

3.5 to 5.1 mmol/L is the usual range for potassium levels; readings outside of this range are regarded as abnormal (4). Active transport of potassium across cell membranes is essential for nerve and cardiovascular function. Over 20 percent of hospitalized patients have hypokalemia. Although hypokalemia is often well tolerated by healthy people, even mild or moderate potassium deficit greatly raises the risk of morbidity and death in patients with cardiovascular disease (9).

In patients who went through an acute myocardial infarction, it is independently linked to ventricular fibrillation. Hypokalemia is a major predictor of death in heart failure (10). As a result, potassium plays a complicated role in the development of cardiovascular disease (11).

Chloride abnormalities: Although they are less well-known, chloride anomalies (beyond 96–107 mmol/l) are linked to poor prognoses and mortality in hospitalized patients. Inferior outcomes are associated with many concurrent electrolyte abnormalities, highlighting the significance of early identification and treatment (12). As the second most prevalent serum electrolyte, it aids in maintaining electrical neutrality, acid-base balance, and bodily fluid regulation. Ionic homeostasis, excitability, and cell volume are all impacted by chloride channels (13).
The common arrhythmia of atrial fibrillation (AF) in heart failure (HF) is associated with a worse prognosis, increased hospitalization, mortality, and disease severity. Due to their cause-and-effect relationship, the prevalence of HF and AF is increasing worldwide (14).

Impact of Lifestyle Factors on Cardiovascular Disease Recovery

Approximately 20 to 30 percent of hospitalized patients abuse alcohol. A high alcohol intake raises the risk of cardiac arrhythmias and sudden cardiac death. Alcohol consumption was linked to a higher death rate in people with coronary heart disease. In

patients with abnormal cardiac function, noncompliance with drinking and smoking restrictions, which can be changed, significantly raises the likelihood of readmission to the hospital (15).

A balanced diet, consistent exercise, quitting smoking, and keeping a healthy weight can help prevent most CVD (16).

Medication Adherence in Cardiovascular Disease Management

"Medications don't work on people who don't take them." presently the term "adherence" recognizes the need for a patient and clinician to work together mutually. The various systemic and sociological elements that influence non-adherence are implied in this enlarged concept. One of the main risk factors for treatment failures and unfavorable results is the widespread non-adherence to cardiovascular medicine (17, 18).

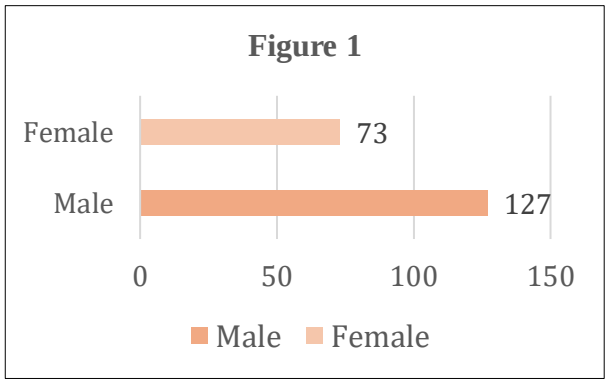
Materials and Methods

This prospective observational study was conducted at a Super speciality Hospital over a period of 6 months, including 200 patients diagnosed with cardiovascular disease (CVD). Approval for the study was granted by the Institutional Human Ethics Committee (BIPS/IEC/2023/P8), and informed consent was obtained from each patient after explaining all relevant aspects of the study in their local language. The inclusion criteria encompassed both male and female patients of any age with cardiac disease, along with those having co-morbidities such as Hypertension (HTN) and Diabetes mellitus (DM). Exclusion criteria ruled out pediatric and pregnant patients, individuals with renal disease, and those undergoing diuretic therapy.

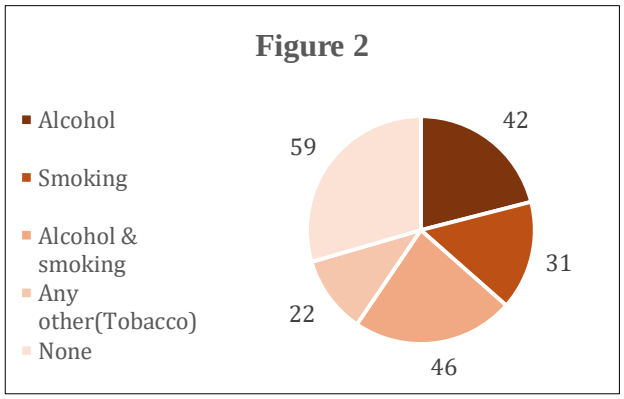
Data collection included demographic details, serum electrolyte levels (sodium, potassium, chloride), and medication adherence, which was assessed through a validated questionnaire.

Additionally, clinical outcomes such as recovery rates were recorded. Electrolyte levels were measured at baseline and during follow-up visits, while recovery status was evaluated at the end of the study period. Pearson's correlation coefficient was employed to analyze the relationship between electrolyte imbalances, medication adherence, and recovery rates.

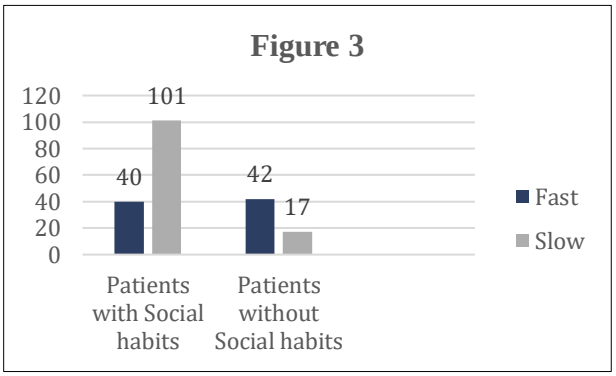
Results: Data was gathered and processed using an Excel proforma, and the observations were represented through pie charts, column graphs, and bar graphs. Patients with cardiac disease, including males and females at any age, were included in this study.



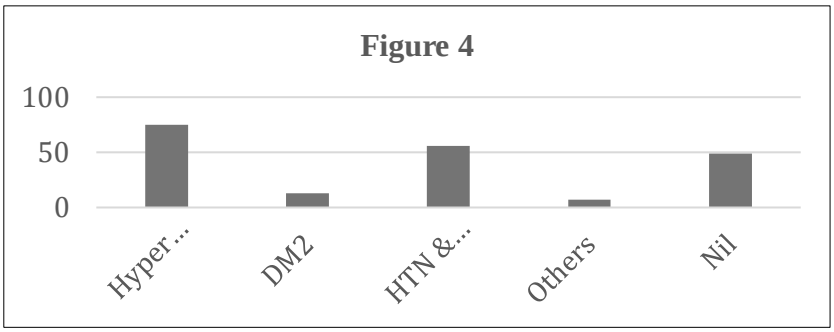
Gender Distribution (Figure 1): The above graph depicts the information about the involvement of male and female cardiovascular disease (CVD) patients involved in the study. Overall, participant males were more than the females. Out of 200 patients (100%), females were n=73 (36.5%) & males were n=127 (64.5%).



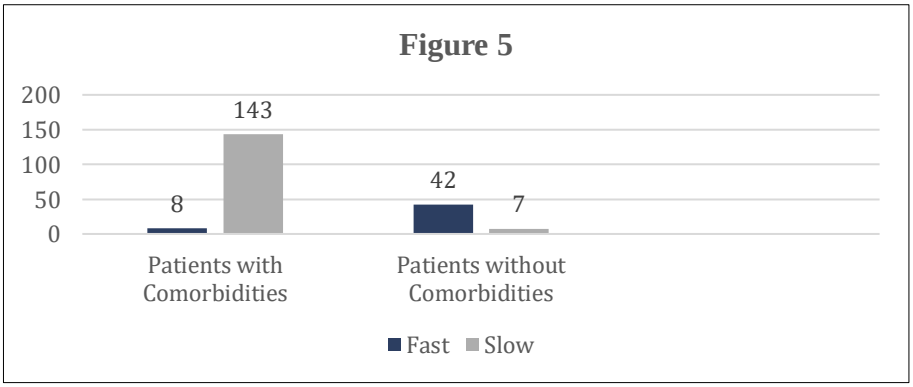
Social Habits Distribution (Figure 2): The above pie chart depicts the information on the social habits of the patients involved in the study. Out of 200, 42 (21%) patients have a habit of drinking alcohol, 31 (15.5%) patients smoke, 46 (23%) patients have a habit of drinking and smoking , 22 (11%) patients chew tobacco, and 59 (29.5%) patients have no social habits mentioned above.



Recovery rate based on Social Habits (Figure 3): Based on the above graph, patients without social habits such as alcohol intake, smoking, or tobacco chewing show the fastest recovery rate. Patients who both smoke and consume alcohol, and those who chew tobacco, exhibit the slowest recovery, indicating that avoiding these habits significantly contributes to better recovery outcomes.



Patients with Comorbidities (Figure 4): The above bar graph shows the information on the distribution of patients with comorbidities. The majority of patients (75(37.5%)) have Hypertension.

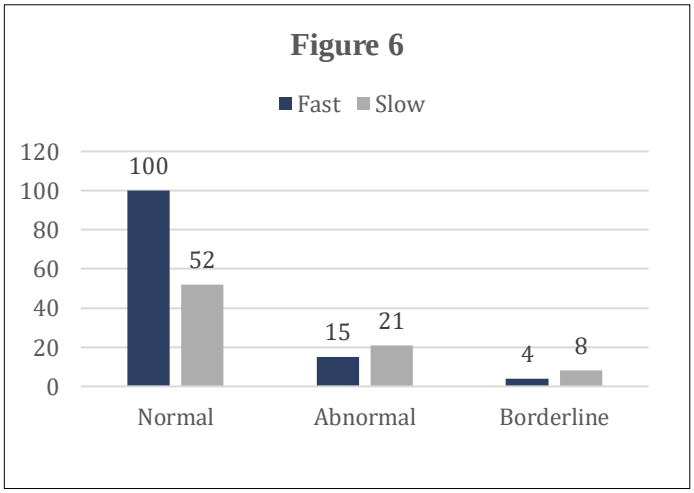


Recovery rate based on Comorbidities (Figure 5): Based on the above graph, the recovery rate of patients without comorbidities is significantly higher compared to those

with comorbidities, demonstrating the impact of additional health conditions on the overall recovery process.

Serum Sodium levels	No. of patient's	Recovery rate (Fast)	Slow Recovery (Slow)
Normal	152 (76%)	100 (50%)	52 (26%)
Abnormal	36 (18%)	15 (7.5%)	21 (10.5%)
Borderline	12 (6%)	4 (2%)	8 (4%)

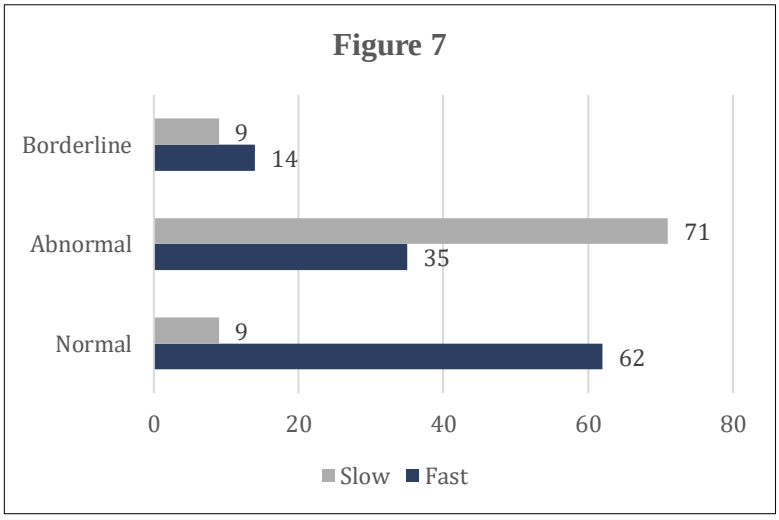
Table 1: Distribution of Serum sodium (Sr. Na^+) levels and the Recovery rates:



Recovery rate based on Sr. Na^+ levels (Figure 6): Above bar graph shows the Sr. Na^+ levels recovery rate of patients based on their Sr. Na^+ levels. Patients with normal Sr. Na^+ levels exhibit a faster recovery rate than those with abnormal and borderline levels, indicating that normal sodium levels leads to better recovery outcomes.

Serum Potassium levels	No. of patient's	Recovery rate (Fast)	Slow Recovery (Slow)
Normal	71 (35.5%)	62 (31%)	09 (4.5%)
Abnormal	106 (53%)	35 (17.5%)	71 (35.5%)
Borderline	23 (11.5%)	14 (7%)	09 (4.5%)

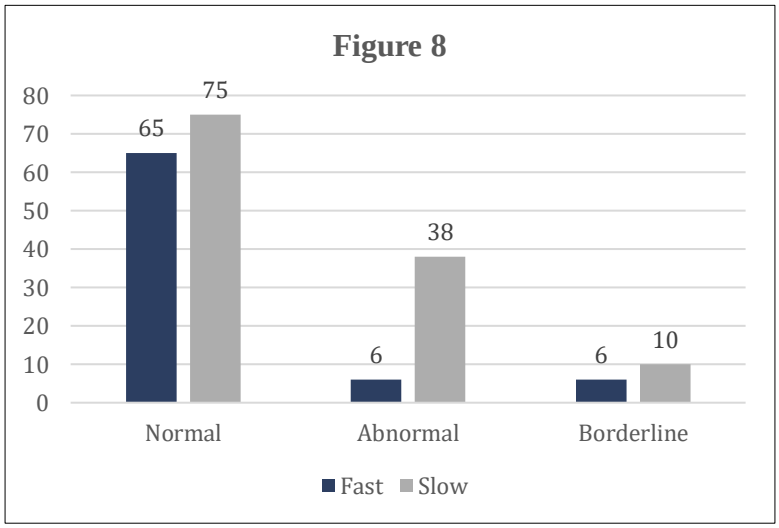
Table 2: Distribution of Serum potassium (Sr. K^+) levels and the Recovery rates:



Recovery rate based on Sr. K+ levels (Figure 7): Above graph portrays the recovery rate of patients based on their Sr. K^+ levels. Patients with normal and borderline Sr. K^+ levels exhibit faster recovery rate compared to those with abnormal levels, indicating that maintaining normal potassium levels leads to better recovery outcomes.

Table 3: Distribution of Serum Chloride (Sr. Cl^-) levels and the Recovery rates:

Serum Chloride levels	No. of patient's	Recovery rate (Fast)	Slow Recovery (Slow)
Normal	152 (76%)	100 (50%)	52 (26%)
Abnormal	36 (18%)	15 (7.5%)	21 (10.5%)
Borderline	12 (6%)	4 (2%)	8 (4%)



Recovery rate based on Sr. Cl^- levels (Figure 8): Above graph shows the recovery rate of patients based on their Sr. Cl^- levels. Patients with normal and borderline Sr. Cl^- levels exhibit a faster recovery rate than those with abnormal levels, indicates that normal chloride levels leads to better recovery outcomes.

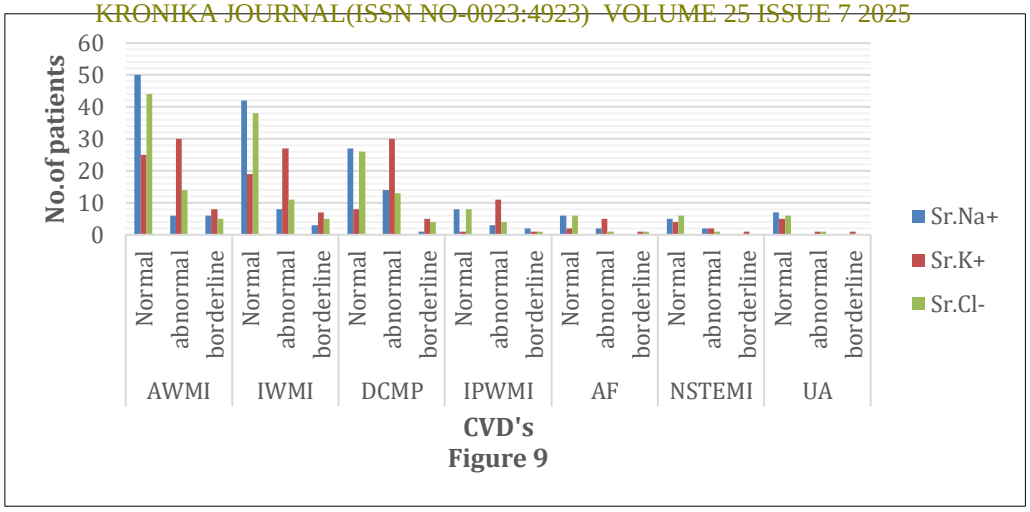
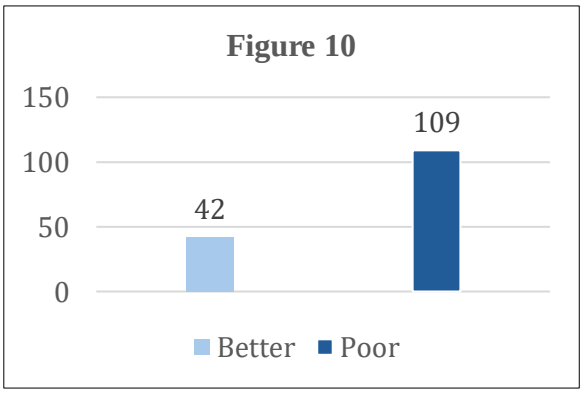
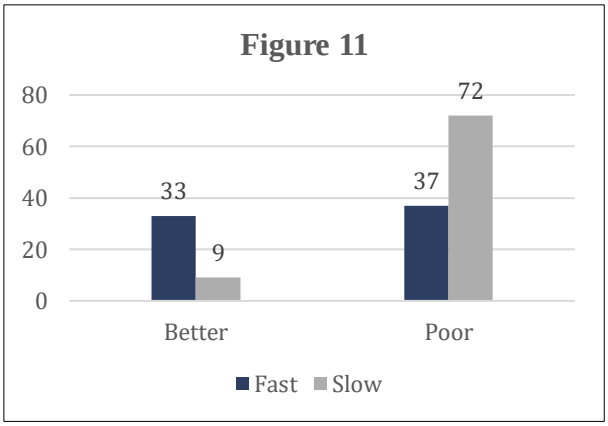


Figure 9

CVD's - Electrolyte anomalies: As shown in Figure 9, patients with AWMI and DCMP are more likely to have electrolyte abnormalities than those with other cardiovascular conditions.



Distribution of Medication Adherence of the patients with Comorbidities: The above bar graph (Figure 10) depicts the information on Medication adherence of the patients with Comorbidities involved in this study. In detail, out of the 151 (75.5%) patients with comorbidities, 42 (21%) exhibited better medication adherence, while 109 (54.5%) showed poor adherence.



Recovery Rate Based on Medication Adherence: Based on the graph (Figure 11), patients with better medication adherence demonstrate a significantly faster recovery rate compared to those with poor medication adherence, underscoring the critical role of consistent and proper medication use in the recovery process.

Discussion

This study underscores the critical impact of electrolyte imbalances, particularly hypokalemia, and medication adherence on cardiovascular disease recovery rates. In our study, abnormal serum potassium levels were present in 53% of patients, affecting cardiac function. This aligns with findings from Choi et al. 2014 (3), who demonstrated that abnormal potassium levels were associated with poorer long-term outcomes in acute myocardial infarction patients.
Our findings show that patients with normal or borderline potassium levels recover significantly faster, underscoring the importance of electrolyte balance for cardiac function. This is consistent with Macdonald and Struthers 2004 (10), who investigated optimal serum potassium levels in cardiovascular patients and found that maintaining appropriate levels improves outcomes.

The study also highlights the impact of lifestyle factors, such as diet and social habits, on recovery. Among participants, 59.5% reported smoking, alcohol consumption, or both. Hu and Willett 2002 (16) established that dietary patterns significantly influence cardiovascular disease prevention and recovery.

Moreover, our study found that 54.5% of patients had poor medication adherence, correlating with slower recovery rates. This aligns with Kolandaivelu et al. 2014 (17), who identified non-adherence as a major factor in poorer cardiovascular outcomes. Brown and Bussell 2011 (18) further emphasized that medication adherence is a multifaceted issue requiring attention from all healthcare stakeholders to improve patient outcomes.

Our Pearson's correlation analysis showed a strong positive association ($r = 0.8395$) between electrolyte imbalances and slower recovery rates, suggesting that increased electrolyte abnormalities are linked to slower recovery.

Conclusion

The study comes to the conclusion that electrolyte imbalances, especially abnormal serum potassium levels, have a major impact on recovery in individuals with cardiovascular disease and are essential for heart function. Recovery can be slowed by

abnormal potassium levels, particularly hypokalemia, which can worsen arrhythmias, affect cardiac function, and raise the risk of cardiovascular problems. Patients who had electrolyte levels (Sr. Na^+, Sr. K^+, Sr. Cl^-) that were within or close to normal recovered more quickly, highlighting how crucial electrolyte balance is. It was also discovered that recovery rates were influenced by comorbidities, medication adherence, dietary practices, and social behaviors (such as smoking and drinking).

These outcomes highlights the need for interventions not only to correct electrolyte anomalies but also to promote better lifestyle choices and adherence to medication regimens to optimize patient outcomes and enhance recovery rates.

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