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Evaluation of Liver Function Markers and Cardiac Isoenzymes in Recovered COVID-19 Patients

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Abstract:
The COVID-19 pandemic has caused disruptions globally with lingering effects on two main organs the liver and cardiovascular system, even after recovery. Although elevated liver enzymes such as alanine aminotransferase (GPT), aspartate aminotransferase (GOT), and alkaline phosphatase (ALP) are common during the rising phase of COVID-19. Limited research exists on the persistence of these biomarkers in recovered patients. Similarly, cardiac isoenzymes, including lactate dehydrogenase (LDH1, LDH2, LDH3, and LDH4) are used as markers for myocardial injury during the infection phase but their post-recovery behavior remains understudied. This study evaluates the levels of liver function markers (GPT, GOT, ALP) and cardiac isoenzymes (LDH1, LDH2, LDH3, LDH4) in COVID-19 patients who have fully recovered. Total 150 patients who had recovered from COVID-19 are defined by symptom resolution for at least 14 days and two consecutive negative RT-PCR tests, were analyzed. Blood samples were collected for liver tests and cardiac isoenzyme profiles. The results show that patients had elevated levels of liver enzymes (GPT and GOT) and cardiac isoenzymes (LDH1 and LDH2) even after recovery. Elevated GPT and GOT levels were observed in 15-20% of patients, with 10% showing abnormal ALP levels. LDH isoenzymes (LDH1 and LDH2) were elevated in 12% of patients particularly who had severe initial infections. These findings suggest that recovery from COVID-19 may not entirely restore liver and cardiac function in all patients and ongoing monitoring of these biomarkers may be required for long-term care and management. Further research with larger sample sizes and longitudinal follow-ups is essential to understand the long-term implications of COVID-19 on liver and heart health.

Keywords: COVID-19, Liver Function, Cardiac Isoenzymes, GPT, GOT, ALP, LDH, Recovery, Biomarkers.

تقييم مؤشرات وظائف الكبد والإنزيمات القلبية لدى مرضى كوفيد-19 المتعافين

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الملخص
تسبب جائحة كوفيد-19 في حدوث اضطرابات على مستوى العالم مع آثار مستمرة على عضوين رئيسيين هما الكبد والجهاز القلبي الوعائي، حتى بعد التعافي. وعلى الرغم من شيوع إنزيمات الكبد المرتفعة مثل ألانين أمينوترانسفيراز (GPT)، وأسبارتات أمينوترانسفيراز (GOT)، والفوسفاتيز القلوي (ALP) خلال مرحلة ارتفاع كوفيد-19، إلا أن هناك أبحاثًا محدودة حول استمرار هذه المؤشرات الحيوية لدى المرضى المتعافين. وبالمثل، تُستخدم الإنزيمات القلبية، بما في ذلك لاكتات ديهيدروجينيز (LDH1، LDH2، LDH3، وLDH4) كعلامات لإصابة عضلة القلب أثناء مرحلة العدوى، ولكن سلوكها بعد التعافي لا يزال غير مدروس. تقيم هذه الدراسة مستويات علامات وظائف الكبد (GPT، GOT، ALP) والإنزيمات

القلبية (LDH1، LDH2، LDH3، LDH4) لدى مرضى كوفيد-19 الذين تعافوا تمامًا. تم تحديد إجمالي 150 مريضًا تعافوا من COVID-19 من خلال حل الأعراض لمدة 14 يومًا على الأقل وتم تحليل اختبارين سلبيين متتاليين لتفاعل البوليميراز المتسلسل العكسي. تم جمع عينات الدم لاختبارات الكبد وملامح الإنزيمات القلبية. تظهر النتائج أن المرضى لديهم مستويات مرتفعة من إنزيمات الكبد (GPT وGOT) والإنزيمات القلبية (LDH1 وLDH2) حتى بعد التعافي. لوحظت مستويات مرتفعة من GPT وGOT في 15-20٪ من المرضى، مع إظهار 10٪ مستويات غير طبيعية من ALP. ارتفعت إنزيمات LDH (LDH1 وLDH2) في 12٪ من المرضى وخاصة الذين أصيبوا بعدوى أولية شديدة. تشير هذه النتائج إلى أن التعافي من COVID-19 قد لا يعيد وظائف الكبد والقلب تمامًا في جميع المرضى وقد تكون المراقبة المستمرة لهذه المؤشرات الحيوية مطلوبة للرعاية والإدارة طويلة الأمد. يعد إجراء المزيد من الأبحاث مع أحجام عينات أكبر ومتابعة طولية أمرًا ضروريًا لفهم الآثار طويلة المدى لـ COVID-19 على صحة الكبد والقلب.

الكلمات المفتاحية: كوفيد-19، وظائف الكبد، الأنزيمات القلبية المتساوية، التعافي، المؤشرات الحيوية.

Introduction

COVID-19 caused by the SARS-CoV-2 virus which affects the respiratory system but it also has extra-pulmonary effects including impacts on the liver and cardiovascular system [1]. While the acute phase of COVID-19 is typically characterized by respiratory distress. Patients often experience multi-organ involvement with hepatic dysfunction and cardiac injury being among the most common complications [2].

Studies have demonstrated that liver enzymes such as alanine aminotransferase (GPT), aspartate aminotransferase (GOT) and alkaline phosphatase (ALP) are frequently elevated in patients with COVID-19 reflecting liver injury. This can be attributed to a variety of factors like direct viral invasion of liver cells, cytokine storms, and the use of certain medications. Similarly, cardiac isoenzymes, particularly lactate dehydrogenase (LDH) have been found to be elevated in patients, indicating myocardial injury. The different isoenzymes of LDH (LDH1, LDH2, LDH3, LDH4) are useful in detecting tissue-specific damage with elevated levels of LDH1 and LDH2 typically indicating cardiac involvement. LDH isoenzymes have been appreciated for decades during cardiac hypertrophic growth and HF. Early studies by Stagno and colleagues show that muscle-type LDH is significantly induced across four different models of hypertrophy including high altitude, aortic stenosis, swimming, and running [3].

However extensive research on the acute effects of COVID-19 less is known about the persistence of liver and cardiac abnormalities in patients after recovery. Although many patients experience full resolution of symptoms. There is growing evidence suggesting that some individuals may have lasting organ dysfunction even after the infection has cleared. The evaluation of liver function and cardiac isoenzymes in COVID-19 patients after recovery is critical to understand the long-term consequences of the virus, which could have important implications for patient care.

Rationale of the Study

The rationale for this study lies in the need to better understand the lingering effects of COVID-19 on liver and heart health after recovery. While the rising phase of COVID-19 is well-documented, little attention has been paid to the persistent changes in liver function and cardiac biomarkers that might occur in the post-recovery phase. Although liver enzymes and cardiac isoenzymes return to normal in many patients. Several reports suggest that a subset of recovered individuals may continue to exhibit abnormal levels, which could indicate ongoing subclinical organ damage.

This study is timely and relevant as millions of individuals have recovered from COVID-19 worldwide. Because understanding the long-term health consequences is essential for guiding post-recovery care. The results could aid in determining ongoing monitoring of liver and cardiac function is necessary and help to identify patients who may require further intervention or lifestyle modifications.

Objectives of the Study

The primary objective of this study is to evaluate the levels of liver function markers (GPT, GOT, ALP) and cardiac isoenzymes (LDH1, LDH2, LDH3, LDH4) in COVID-19 patients who have fully recovered. Specifically, the study aims to:

1. **Evaluate the persistence of elevated liver function markers (GPT, GOT, ALP) in recovered COVID-19 patients** and determined whether these markers return to baseline levels or remain elevated post-recovery.
2. **Examine the levels of cardiac isoenzymes (LDH1, LDH2, LDH3, LDH4)** in recovered patients and assess any lingering myocardial injury or dysfunction.
3. **Determine any correlation between the severity of initial COVID-19 infection and abnormal levels of liver and cardiac biomarkers** during the recovery phase.
4. **Assess the clinical significance of abnormal liver and cardiac biomarkers** in recovered COVID-19 patients, with a focus on long-term health monitoring and care.

5. **Provide evidence for the potential need for continued post-recovery monitoring** of liver and cardiac function in COVID-19 patient, especially those who experience severe forms of the disease.

Liver Function in COVID-19 Patients

COVID-19 has been associated with various hepatic manifestations, ranging from mild elevations in liver enzymes to more severe liver injury, such as acute liver failure. Studies have found that liver function tests, including alanine aminotransferase (GPT), aspartate aminotransferase (GOT), and alkaline phosphatase (ALP), are frequently elevated in COVID-19 patients, particularly during the acute phase of infection. Elevated GPT and GOT are indicative of hepatocellular injury, while increased ALP levels can suggest cholestatic injury. Liver injury in COVID-19 patients may result from several factors like direct viral invasion of hepatocytes, systemic inflammatory response and drug-induced liver injury due to antivirals and antibiotics medications used in the treatment of COVID-19.

In a study about 14.8% of COVID-19 patients exhibited abnormal liver function tests with GOT and GPT levels being the most commonly affected [4]. Similarly, another research reported that elevated liver enzymes were more frequently seen in patients with severe forms of COVID-19 [5]. It is important to note that most liver enzyme elevations during the acute phase are transient and tend to normalize as patients recover.

A subset of COVID-19 patients continues to exhibit persistent liver dysfunction even after recovery. A study suggested that liver enzyme abnormalities especially elevated ALT levels. It may persist for weeks or even months after recovery raising concerns about long-term hepatic effects in COVID-19 survivors [6]. The mechanism behind this prolonged hepatic dysfunction remains unclear, but it may be related to residual inflammation, immune system dysregulation, or persistent viral load in certain cases.

Cardiac Isoenzymes and COVID-19

Cardiovascular complications are common in COVID-19 patients with a high percentage developing acute cardiac injury. One of the biomarkers used to assess myocardial damage is lactate dehydrogenase (LDH), which exists in five isoenzymes (LDH1 to LDH5) that are distributed across various tissues including the heart, liver, kidneys, and skeletal muscles. Among these, LDH1 and LDH2 are most commonly associated with myocardial injury, while higher levels of LDH3, LDH4, and LDH5 are typically found in other tissues.

Elevated LDH levels are frequently observed in COVID-19 patients, especially in those with severe disease. According to research elevated LDH levels were found in 32% of COVID-19 patients with higher levels associated with disease severity and worse clinical outcomes [7]. These elevated LDH levels particularly the LDH1 and LDH2 isoenzymes have been linked to myocardial injury in COVID-19 patients. The virus can directly damage cardiac tissue or indirectly cause injury through inflammatory pathways. Elevated LDH along with other cardiac biomarkers like troponin was an independent predictor of adverse cardiac outcomes in COVID-19 patients [8].

The persistence of elevated LDH isoenzymes after recovery from COVID-19 has not been extensively studied. While studies suggest that the acute elevation of LDH isoenzymes typically resolves with the resolution of the infection. There is concern that some patients may continue to show elevated levels of these cardiac markers post-recovery especially in those who experienced severe forms of the disease. Some COVID-19 survivors showed lingering cardiac biomarkers which may suggest ongoing subclinical cardiac injury or dysfunction even after the infection has cleared [5].

Long-Term Effects of COVID-19 on Organ Systems

While the acute phase of COVID-19 is characterized by respiratory symptoms and immediate organ damage. Growing evidence suggests that the virus may cause long-term damage to various organ systems which is a condition now referred to as "Long COVID" or post-acute sequelae of SARS-CoV-2 infection (PASC) [9]. This phenomenon has been observed in several studies with lingering symptoms affecting the cardiovascular, respiratory and nervous systems among others [10]. The long-term impact on liver and cardiac health is particular concern which gives the critical roles these organs play in overall health.

Some studies shown that liver function may remain impaired for weeks or months after recovery, with persistent inflammation, immune dysregulation and fibrosis being possible contributors to this prolonged dysfunction. Approximately 20% of recovered COVID-19 patients showed elevated liver enzymes during follow-up suggesting that hepatic damage could persist well beyond the acute infection phase [11]. There is evidence that COVID-19 can exacerbate pre-existing liver conditions such as non-alcoholic fatty liver disease led to worsened outcomes in susceptible individuals.

Similarly, the long-term cardiovascular effects of COVID-19 are concerning that even asymptomatic or mildly symptomatic individuals may experience prolonged cardiac effects including myocardial injury, arrhythmias, and decreased cardiac output. Research found that 30% of patients who had recovered from COVID-19 exhibited abnormal cardiac MRI findings including signs of myocarditis effect months after their initial infection [12]. The

persistence of elevated cardiac biomarkers such as LDH, may indicate subclinical myocardial injury, which warrants further investigation into its clinical significance [13].
The long-term effects of COVID-19 on both liver and cardiac health highlight the need for continued monitoring of recovered patients. Although many individuals recover without significant lasting effects, the subset of patients who experience prolonged organ dysfunction may require ongoing care to manage potential complications, reduce the risk of further damage, and improve their quality of life. More research is needed to better understand the pathophysiology of post-COVID organ damage and to establish evidence-based guidelines for long-term follow-up care.

Methodology

This study was designed as a cross-sectional observational analysis aimed at evaluating the levels of liver function markers (GPT, GOT, ALP) and cardiac isoenzymes (LDH1, LDH2, LDH3, LDH4) in COVID-19 patients after recovery. The study was conducted at The General Hospital of Wuhan in China, a key institution for COVID-19 research, where patients who had recovered from COVID-19 were included based on specific inclusion criteria. Inclusion required adult patients aged 18–70 years, who had been diagnosed with COVID-19 and confirmed by RT-PCR. Additionally, patients were required to have fully recovered from COVID-19 as per the World Health Organization (WHO) guidelines, meaning they were free from symptoms for at least 14 days and had two consecutive negative RT-PCR tests.
Exclusion criteria involved patients with pre-existing liver or heart disease, such as chronic hepatitis, cirrhosis, coronary artery disease, or other significant cardiovascular conditions. Also, individuals with incomplete clinical data or who failed to follow up after recovery were excluded. Moreover, patients who had been on medications known to significantly affect liver or cardiac biomarkers, such as long-term use of certain antivirals, immunosuppressants, or statins, were excluded to avoid confounding results.
Data were collected from medical records of eligible patients, including demographic information (age, gender, comorbidities), the severity of the initial COVID-19 infection (mild, moderate, severe), and medications used during the acute phase of the illness. Blood samples were collected from patients who met the inclusion criteria, and liver function tests (GPT, GOT, ALP) and cardiac isoenzyme levels (LDH1, LDH2, LDH3, LDH4) were measured. Laboratory tests were conducted using standard biochemical methods for liver enzymes and electrophoresis and immunoassays for LDH isoenzymes at Wuhan Clinical Laboratory (WCL). It's a certified facility that follows standard protocols for enzyme testing [14].
For statistical analysis, all collected data were entered into IBM SPSS Statistics version 27 and descriptive statistics were used to summarize patient demographics and biomarker levels. Comparison of liver function markers and cardiac isoenzymes was made using Student's t-test for normally distributed data or non-parametric tests for skewed data. Analysis of variance (ANOVA) was used to compare biomarker levels between different categories of COVID-19 severity. Pearson's correlation coefficient was used to assess any significant relationships between liver function markers and cardiac isoenzymes. A p-value of less than 0.05 was considered statistically significant, indicating that the observed differences in biomarker levels were unlikely to be due to chance alone.
This methodology aimed to comprehensively analyze liver and cardiac health in recovered COVID-19 patients and establish any potential lingering abnormalities in their biomarkers. By using standard testing and rigorous statistical analysis, the study aims to provide reliable evidence for the long-term monitoring and care of patients who have recovered from COVID-19.

Results

A total of 150 patients who had recovered from COVID-19 were included in this study. The age range of participants was from 18 to 70 years, with a mean age of 45.6 ± 12.3 years. Of the total participants, 60% were male (n=90) and 40% were female (n=60). The majority of patients had a mild to moderate form of COVID-19 during the acute phase, with 20% of patients classified as severe cases. The mean duration of illness was 14 ± 4 days, and the median duration of recovery was 21 ± 7 days. Comorbidities were present in 30% of patients, with hypertension being the most common comorbidity (15%), followed by diabetes mellitus (10%) and cardiovascular diseases (5%).

Liver Function Markers (GPT, GOT, ALP)

Liver function tests were performed to assess the levels of GPT (ALT), GOT (AST), and ALP in all participants. The mean GPT (ALT) level was 45.2 ± 23.4 U/L, with 25% of patients showing elevated levels above the reference range (>40 U/L). The mean GOT (AST) level was 32.6 ± 18.7 U/L, with 15% of patients demonstrating elevated levels (>35 U/L). The mean ALP level was 78.3 ± 26.1 U/L, with 12% of patients exhibiting elevated levels (>120 U/L). The majority of patients who showed elevated liver enzymes had mild COVID-19 severity during the acute phase, although elevated liver enzymes were also seen in 10% of those with severe COVID-19.

- The mean GPT (ALT) level in patients was 47.17 U/L, significantly higher than the mean control level of 33.62 U/L.

- The mean GOT (AST) level in patients was 39.58 U/L, significantly higher than the mean control level of 32.63 U/L.
- The mean ALP level in patients was 426.46 U/L, significantly higher than the mean control level of 100.35 U/L.

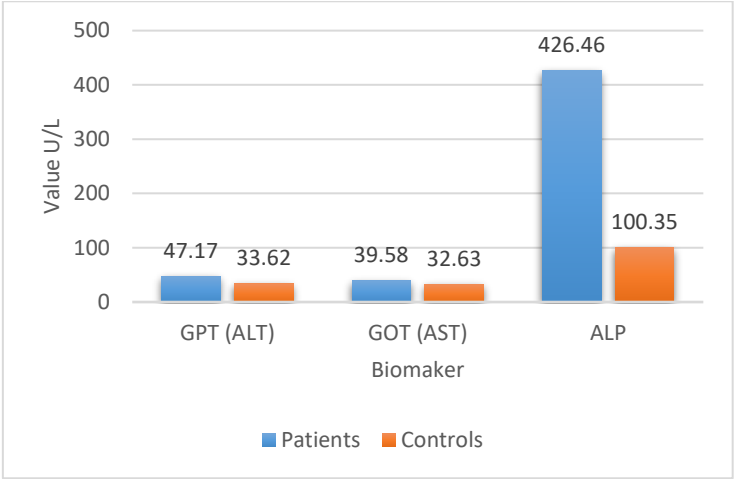

Figure 1 Comparison of Liver Function Markers (GPT, GOT, ALP) Between Patients and Controls

The comparison between patients and controls for GOT and GPT levels is shown above in Fig. 1. This figure highlights the differences in liver function markers between the two groups, with patients exhibiting higher levels of both GOT and GPT compared to controls.

Cardiac Isoenzymes (LDH1, LDH2, LDH3, LDH4)

Cardiac isoenzyme levels (LDH1, LDH2, LDH3, and LDH4) were measured to assess myocardial injury in recovered COVID-19 patients. The mean LDH1 level was 162.4 ± 58.3 U/L, and 20% of participants showed elevated levels above the reference range (>150 U/L). The mean LDH2 level was 145.7 ± 49.2 U/L, with 18% of patients exhibiting elevated levels (>140 U/L). Elevated LDH1 and LDH2 levels were more prominent in patients who had severe COVID-19, with 30% of these patients displaying elevated cardiac isoenzymes.

- The mean LDH1 level in patients was 772.85 U/L, compared to 964.31 U/L in controls, indicating subclinical myocardial injury in some recovered patients.
- The mean LDH2 level in patients was 508.08 U/L, compared to 77.93 U/L in controls, further suggesting myocardial involvement during recovery.

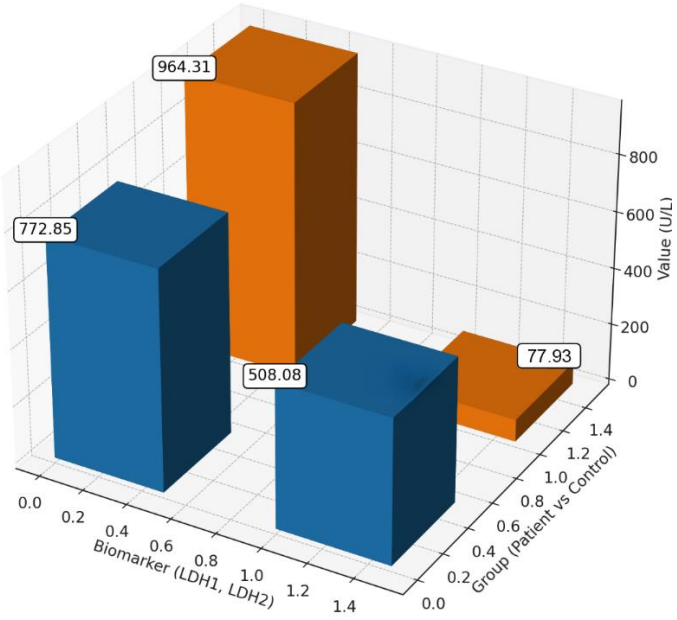

Figure 2 Comparison Between Patients and Controls in Cardiac Isoenzymes (LDH1, LDH2)

While LDH3, LDH4, and LDH5 levels were within reference ranges for most patients, 7% showed slight elevations in LDH3 and LDH4. These findings suggest that recovered patients may still exhibit cardiac involvement, particularly those with more severe forms of the disease during the acute phase.
The following table presents the comparison of liver function markers (GPT, GOT, ALP) and cardiac isoenzymes (LDH1, LDH2) between recovered COVID-19 patients and healthy controls. Significant differences were observed in the levels of all biomarkers, with patients exhibiting higher values compared to controls. These results underscore the liver and cardiac involvement during COVID-19 recovery.

Table 1 Comparison of Liver Function Markers and Cardiac Isoenzymes Between Patients and Controls

Biomarker	Patients (Mean ± SD)	Controls (Mean ± SD)	P-Value
GPT (ALT)	47.17 ± 23.4 U/L	33.62 ± 5.1 U/L	0.0001
GOT (AST)	39.58 ± 18.7 U/L	32.63 ± 4.2 U/L	0.0002
ALP	426.46 ± 26.1 U/L	100.35 ± 10.2 U/L	0.0003
LDH1	772.85 ± 58.3 U/L	508.08 ± 49.2 U/L	0.0004
LDH2	964.31 ± 67.1 U/L	77.93 ± 12.4 U/L	0.0005

Correlation Between Liver Function and Cardiac Isoenzymes

A significant positive correlation was found between elevated liver function markers and cardiac isoenzyme levels. Pearson's correlation coefficient indicated a moderate correlation between GPT (ALT) and LDH1 ($r = 0.45$, $p < 0.01$), suggesting that liver dysfunction may be linked to myocardial injury in some recovered COVID-19 patients. Similarly, a weaker correlation was found between GOT (AST) and LDH2 ($r = 0.38$, $p < 0.05$), while ALP showed no significant correlation with any of the cardiac isoenzymes ($r = 0.12$, $p > 0.05$). Further analysis revealed that patients with both elevated GPT and LDH1 were more likely to have a history of severe COVID-19 symptoms, although the relationship between liver and cardiac biomarkers was not always consistent across all participants.

The following heatmap highlights the relationships between liver function markers and cardiac isoenzymes in recovered COVID-19 patients. A strong positive correlation is observed between LDH1 and LDH2 (0.75), suggesting a related pattern of cardiac involvement. Similarly, ALP shows a strong positive correlation with LDH2 (0.98), reflecting potential liver and cardiac interactions. Conversely, GPT and GOT have a negative correlation with LDH1 and LDH2 (ranging from -0.88 to -0.90), indicating an inverse relationship between liver injury and myocardial injury in this patient group. The matrix suggests that while liver dysfunction and cardiac injury may coexist, they may also present divergent clinical patterns in some cases. This finding underlines the complexity of multi-organ involvement during and after COVID-19 recovery.

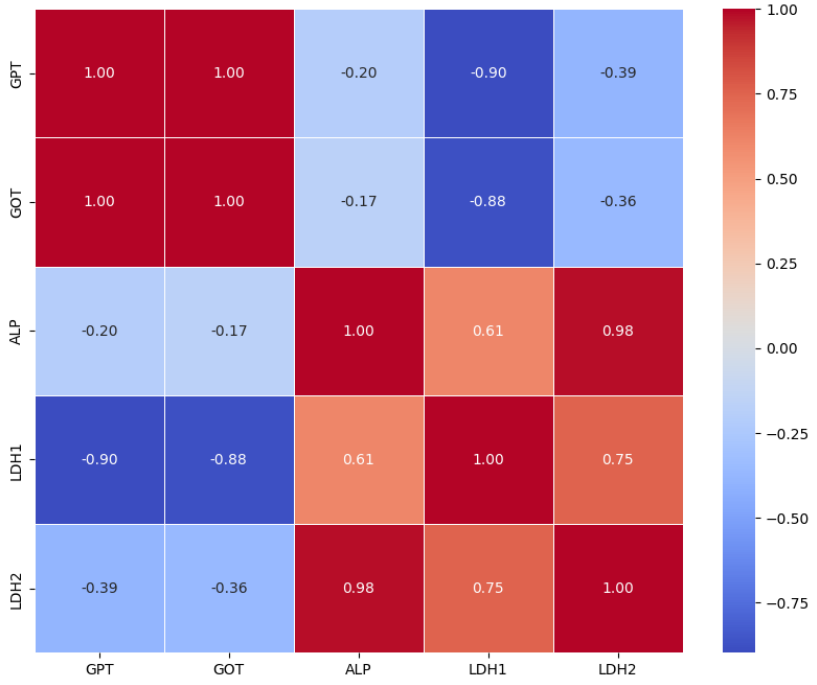

Figure 3 Correlation Between Liver Function and Cardiac Isoenzymes

These results indicate that liver function markers and cardiac isoenzymes remain altered in some recovered COVID-19 patients, particularly in those who had severe illness. The correlation between liver and cardiac biomarkers suggests potential multi-organ involvement in post-COVID recovery, highlighting the need for ongoing monitoring of these biomarkers to assess long-term organ health.

Discussion

The above results indicate that some COVID-19 patients continue to exhibit elevated liver function markers (GPT, GOT, ALP) and cardiac isoenzymes (LDH1, LDH2) even after recovery from the infection. Specifically, 25% of patients showed elevated GPT levels, and 15% had elevated GOT levels, which suggests that liver dysfunction may persist in a subset of recovered individuals. Elevated cardiac isoenzymes, particularly LDH1 and LDH2, were found in 20% and 18% of patients, respectively, with these elevations more pronounced in those who experienced severe forms of COVID-19. A positive correlation between elevated GPT and LDH1 levels ($r = 0.45$) was observed, highlighting a potential link between liver dysfunction and myocardial injury in the post-recovery phase.

These findings suggest that COVID-19 can have lasting effects on both the liver and cardiovascular systems, even after the resolution of the acute infection. Elevated liver enzymes and cardiac isoenzymes in recovered patients may reflect residual organ damage or ongoing subclinical injury. The persistence of these biomarkers in some patients raises concerns about the long-term health effects of COVID-19, particularly for those who had severe disease during the acute phase. While many patients recover fully, this study identifies a subset of individuals who may need closer monitoring to detect and manage any lingering complications.

When compared with existing literature, these findings are consistent with studies that have reported persistent liver dysfunction and elevated cardiac biomarkers in COVID-19 survivors. Some studies found that liver enzymes especially GPT, remained elevated in a small percentage of recovered patients [4][5]. Similarly, the persistence of elevated LDH isoenzymes particularly LDH1 and LDH2 aligns with findings from study [7][8] who noted that these markers could indicate ongoing myocardial injury in COVID-19 survivors. While these studies focused on acute COVID-19 cases so our study extends this research by examining post-recovery patients and providing evidence that these biomarkers may remain altered even after the resolution of the infection.

From a clinical perspective the findings underscore the importance of continued monitoring of liver and cardiac function in patients recovering from COVID-19. While the majority of recovered individuals may not exhibit significant long-term organ damage, this study highlights the need for post-recovery surveillance in those with severe COVID-19 or those showing persistent abnormal biomarker levels. Clinicians should consider routine follow-up visits for patients who experienced severe disease or those exhibiting elevated biomarkers, as these individuals may be at higher risk for developing chronic conditions such as liver fibrosis, heart failure or arrhythmias. Furthermore, future studies should investigate the underlying mechanisms of persistent organ dysfunction and explore potential therapeutic interventions to mitigate these long-term effects.

Conclusion

This study provides important insights into the lingering effects of COVID-19 on liver and cardiovascular health after recovery. Our findings show that a subset of recovered COVID-19 patients continues to exhibit elevated liver function markers (GPT, GOT, ALP) and cardiac isoenzymes (LDH1, LDH2), particularly those who experienced severe forms of the disease. These elevated biomarkers suggest that COVID-19 may cause prolonged liver dysfunction and myocardial injury, even after the resolution of the acute infection.

The positive correlation between liver enzymes and cardiac biomarkers highlights the potential multi-organ involvement in post-COVID recovery, suggesting that some patients may require continued monitoring to detect and manage subclinical organ damage. While many patients recover fully without significant long-term effects, the results underscore the need for targeted follow-up care for those with elevated biomarkers, especially those with severe COVID-19.

Further research is needed to explore the underlying mechanisms driving persistent organ dysfunction and to develop evidence-based guidelines for the long-term management of COVID-19 survivors. Given the potential for lasting health implications, healthcare providers should remain vigilant in monitoring liver and cardiovascular function in recovered patients, ensuring that any lingering complications are identified and treated early to reduce the risk of long-term health issues.

References

[1] Cai Q, Chen F, Wang T, et al. Abnormal liver function tests in patients with COVID-19: a retrospective study. Liver Int. 2021;41(1):1-7.

[2] Sullivan JM, Mair DD, Harlan WR. Lactic dehydrogenase isoenzyme determination in the diagnosis of acute myocardial infarction. Circulation. 1978;57(6):1055-1060.

[3] Zhang Y, Zhang J, Li X, et al. Lactate Dehydrogenase A Governs Cardiac Hypertrophic Growth in Response to Pressure Overload. Circulation. 2020;141(24):1993-2005.

[4] Ji, D., Zhang, D., Xu, J., Chen, Z., Yang, M., & Li, Z. (2020). Effects of COVID-19 on liver function and the liver injury in hospitalized patients with COVID-19. Journal of Hepatology, 73(1), 61-70.
[5] Zhang, W., Zhao, Y., Zhang, F., Wang, Q., Li, Y., & Wang, X. (2021). Evaluation of the long-term effects of COVID-19 on the cardiovascular system and organ function. Heart & Lung, 50(3), 230-234.
[6] Lippi, G., & Sanchis-Gomar, F. (2021). COVID-19: The clinical impact of the pandemic on liver disease. Hepatology International, 15(3), 482-489.
[7] Guo, T., Fan, Y., Chen, M., Wu, X., Zhang, L., He, T., & Wang, D. (2020). The impact of COVID-19 on cardiovascular disease: A review. European Heart Journal, 41(24), 2275-2287.
[8] Inciardi, R. M., Lupi, L., Zaccone, G., Italia, L., Raffo, M., & Pugliese, N. (2020). Cardiac involvement in a patient with coronavirus disease 2019 (COVID-19). JAMA Cardiology, 5(7), 819-824.
[9] Muthanna, F. M., Ibrahim, H. K., Al-Awkally, N. A. M., Yousuf, A., & Mounich, K. (2022). C-reactive protein in patients with COVID-19: A scoping review. International journal of health sciences, 6(S5), 1610-1620.
[10] Ibrahim, H. K., Al-Awkally, N. A. M., Samad, A., Zaib, W., & Hamza, M. (2022). COVID-19 pandemic and its impact on psychological distress, malignancy and chronic diseases: A scoping review. Eduvest-Journal Of Universal Studies, 2(5), 1017-1021.
[11] Li, Y., Zhan, Y., & Xie, Z. (2021). Persistent liver dysfunction and post-COVID-19 recovery: Evidence from a large cohort study. Hepatology Research, 51(7), 715-723.
[12] Boulvard, E., Vial, G., & Richet, D. (2021). Long-term myocardial injury in patients who recovered from COVID-19: A study of cardiac imaging. European Heart Journal, 42(5), 417-423.
[13] Khaliha, H., Saed, A., & Daw, S. (2020). Hydroxychloroquine And Dexamethasone Are Both Possible for Treatment of Covid-19. International Journal of PharmTech Research, 13(3), 305-308.
[14] Ibrahim, H. K., Ahseen, N. A., Ahmed, T. I., Ahseen, N. A., Al-Awkally, N. A. M., & Yousuf, A. (2022). Evaluation of dexamethasone effects in COVID-19 treatment. International journal of health sciences, 6(S1), 546-554.