



Original Research Article

Long-Term Effects Caused by Organ Damage Due to COVID-19 Infection: A Mini-Review

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Abstract: COVID-19 is recognized not only for its acute clinical spectrum but also for its persistent, multi-organ sequelae, widely termed "Long COVID." The virus is notorious for causing both symptomatic and asymptomatic organ damage, which contributes to a spectrum of chronic morbidities across cardiac, pulmonary, renal, neurological, and vascular systems. This review synthesizes current findings on the long-term consequences of organ damage induced by COVID-19 and discusses public health implications, clinical considerations, and knowledge gaps.

Keywords: Long COVID, Organ damage, Chronic morbidity, COVID-19 sequelae, public health implications.

INTRODUCTION

Since its discovery, SARS-CoV-2 has caused profound global health disruptions. While initial focus was on acute respiratory effects, mounting evidence suggests COVID-19 leaves a legacy of multi-organ damage. Even seemingly mild or asymptomatic cases may show silent injury, raising concerns about chronic disease burden and healthcare resource requirements in the years ahead^{[1][2][3]}.

MECHANISMS OF POST-COVID ORGAN INJURY

Pathophysiology Overview

- **Immune-Mediated Injury:** COVID-19 triggers a potent immune response, sometimes causing cytokine storms with widespread tissue and vascular injury^{[4][3]}.
- **Viral Invasion:** SARS-CoV-2 enters cells via ACE2 receptors, abundant in the lungs, heart, kidneys, brain, and endothelium, enabling multi-organ involvement^{[3][5]}.
- **Inflammation & Clotting:** Endothelial dysfunction leads to microthrombosis, capillary shunting, and chronic inflammation, which are central to long-term complications^{[6][3]}.

Graphical Illustration

Figure 1: Schematic illustration of the major organ systems damaged by acute and chronic COVID-19.

Long-Term Effects by Organ System

Lungs

- COVID-19 frequently results in residual lung scarring, reduced function, and interstitial changes visible on radiology^{[1][7]}.
- Symptoms: Prolonged dyspnea, persistent cough, lower exercise tolerance, and sometimes pulmonary fibrosis.
- Prevalence: Up to 70% of hospitalized patients show radiologic or functional abnormalities months after recovery^[3].

CARDIOVASCULAR SYSTEM

- **Myocardial Damage:** Elevated troponin and cardiac MRI abnormalities in survivors; persistent myocardial inflammation can be seen in 30–60%^{[4][5]}.
- **Rhythm and Perfusion Issues:** Ongoing arrhythmias, palpitations, postural tachycardia, thromboembolic events, and increased incidence of heart failure, myocardial infarction, and stroke^{[4][6][5]}.
- **Prevalence:** Up to 30% of hospitalized cases show chronic cardiac involvement^[5].

Table 1: Common Cardiovascular Complications After COVID-19

Complication	Prevalence Post-COVID
Myocarditis	10–60% of cases ^{[6][5]}
Arrhythmias	9–20% ^{[4][6]}
Heart Failure	Increased risk by 70% ^{[4][5]}
Thromboembolism/Stroke	12–30% ^{[3][5]}

Kidneys

- **Acute Damage & Progression:** Acute kidney injury (AKI) is common during infection and raises the risk for chronic kidney disease (CKD)^{[1][8][9]}.
- **Consequences:** Affected patients may develop long-term renal impairment, requiring monitoring, and sometimes dialysis.
- **Mechanisms:** Direct viral infection and indirect immune-mediated injury are implicated^[1].

Liver and Metabolic Syndrome

- Elevated liver enzymes common during acute infection; a subset progress to chronic liver inflammation or fibrosis^{[7][3]}.
- Post-infection, there's an increased risk of new diabetes and metabolic syndrome, likely reflecting both direct and indirect (stress, steroid use) factors^{[3][9]}.

Neurological and Neuropsychiatric Sequelae

- **Direct and Indirect Injury:** Brain inflammation, microvascular injury, and neuronal loss have been observed post-infection^{[1][7]}.
- **Cognitive Effects:** “Brain fog,” memory impairment, depression, anxiety, and sleep disorders are reported in 10–30% of survivors^{[2][8]}.
- **Serious Events:** Increased risk of stroke and neurodegenerative disorders in those with preexisting vulnerabilities^{[8][7]}.

Multi-Organ and Systemic Effects

- **Chronic Fatigue Syndrome (CFS) and Dysautonomia:** Pervasive fatigue, orthostatic intolerance, and palpitations are hallmarks of Long COVID^{[2][10]}.
- **Endocrine Dysfunction:** New cases of diabetes and thyroid dysfunction have been observed post-infection^{[3][9]}.
- **Persistent Immune Activation:** Underpins multiorgan involvement, contributing to complex, overlapping syndromes^{[1][3][10]}.

Epidemiology and Risk Factors

Prevalence and Demographics

- Reports estimate that 10–30% of all COVID-19 patients experience persistent symptoms; evidence of subclinical organ damage is even higher, sometimes exceeding 50–70% in imaging studies post-infection^{[1][3]}.

- Higher long-term risk is seen in those with severe acute illness, older age, and pre-existing comorbidities, but younger, healthier individuals are not spared^{[3][5]}.

Repeat Infections

- Repeat COVID-19 infections further increase the risks of cumulative organ damage and mortality, highlighting the need for ongoing prevention efforts^[11].

Clinical and Public Health Implications

- **Health System Burden:** Chronic organ dysfunction will contribute to increased demand on nephrology, cardiology, pulmonology, and mental health services for years to come^[12].
- **Need for Post-COVID Care:** Focused follow-up and screening for new or worsening cardiovascular, pulmonary, and renal disease should be established for COVID-19 survivors^{[5][3]}.
- **Equity Impact:** Disadvantaged populations may suffer disproportionate consequences due to unequal access to care, follow-up, and rehabilitation.

Figures and Graphs

Figure 2: Graph showing prevalence (%) of major organ damage (cardiac, pulmonary, renal, neurological) among COVID-19 survivors at 6- and 12-month follow-up periods.

Figure 3: MRI images demonstrating persistent lung and heart abnormalities in individuals recovering from COVID-19.

CONCLUSION

COVID-19's multi-system effects are not limited to the respiratory tract. Organ injury—frequently chronic and sometimes silent—has far-reaching implications for individual and public health. Continued research is essential to develop effective rehabilitation, targeted treatments, and longitudinal monitoring protocols for survivors. Universal definitions, robust registries, and long-term population-level surveillance are urgently needed to address the growing burden of post-COVID organ damage^{[1][3][5]}.

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