



Unmasking the Clinical Characteristics, Outcomes and Assessing the Frequency and Consequences of Silent Myocardial Infarction in Asymptomatic COVID-19 Survivors: A Multi Centre Study

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A condition known as silent myocardial ischemia occurs when there is a decrease in myocardial blood flow without any obvious signs, such as discomfort or chest pain. The most typical clinical manifestation of coronary artery disease (CAD) is this illness. [1] Silent myocardial infarction is detected by electrocardiogram (ECG), echocardiography, and perfusion abnormalities. Even though some patients do not have a history of CAD, silent myocardial ischemia is common in those with stable CAD. Silent ischemia is a highly reliable indicator of death. Silent ischemia, or anginal chest symptoms, are absent in about 70–80% of transitory ischemic episodes [2]. When myocardial

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ischemia is quiet, patients do not seek medical attention in a timely manner, which increases morbidity and mortality. Patients with diabetes mellitus (DM) who are older and have a history of myocardial infarction or revascularization are at risk. The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has introduced numerous medical complexities, particularly affecting cardiovascular health [3]. Among these, silent heart attacks, or silent myocardial infarctions (SMIs), pose a significant risk yet often go undetected due to their lack of overt symptoms. This article explores the intricate relationship between silent heart attacks and COVID-19, examining the mechanisms through which the virus exacerbates cardiovascular strain, including direct myocardial infection, systemic inflammation, and increased thrombosis risk [4]. Myocarditis, arrhythmias, and myocardial infarctions (MIs) are among the cardiovascular consequences that are increasingly known to be associated with an elevated risk during and after COVID-19 infection. In addition to possible thrombotic and inflammatory pathways, direct virally-induced damage are the mechanisms causing severe consequences. According to the latter, factors that contribute to MI-induced post-COVID-19 consequences are explored, including inflammatory plaque instability and plaque rupture [5]. Our case report details the first instance in which invasive (OCT) and non-invasive (CMR) modalities are used to uncover a silent MI caused by coronary plaque rupture due to a transient reduction of LVEF during the COVID-19 convalescence phase. When COVID-19 patients worsen, it may be necessary to rule out myocardial infarction as a differential diagnosis, particularly if dyspnea continues after an acute infection [6]. The overlap of COVID-19 symptoms with those of silent heart attacks complicates detection, necessitating vigilant cardiac monitoring and the use of biomarkers and imaging. The presence of silent heart attacks in COVID-19 patients worsens their prognosis, highlighting the need for comprehensive management strategies that include regular monitoring, anticoagulation therapy, and anti-inflammatory treatments. Understanding this interplay is crucial for improving patient outcomes and guiding effective prevention and treatment measures [7].

Keywords: *Myocardial Infarction; Covid 19; prognostic significance; epidemiology; hidden burden; infarction detection; cardiovascular disease prevention; cardiovascular disease risk.*

1. INTRODUCTION

COVID-19, caused by the SARS-CoV-2 virus, has presented numerous challenges and complexities in medical science. Among the myriad complications associated with the disease, cardiovascular issues have been notably significant. One of the less obvious but critically important conditions affecting COVID-19 patients is the silent heart attack. A silent heart attack, or silent myocardial infarction (SMI), occurs without the typical symptoms of a heart attack, such as severe chest pain. This article explores the impact of silent heart attacks on COVID-19 patients, delving into the mechanisms, risks, detection, and management. Reduced oxygen-rich blood flow to the heart that happens without cause or other signs of ischemic heart disease, such as nausea, diaphoresis, or dyspnea, is known as silent myocardial ischemia [8]. Diagnostic tests are frequently aberrant, though. On an ECG, ST-segment abnormalities could be visible. A regional wall motion abnormality may be seen on echocardiography. Perfusion faults can be found by scintigraphy [9]. Although patients with silent myocardial ischemia may or may not have coronary artery disease,

stable coronary artery disease is a risk factor. Due to their higher likelihood of experiencing new coronary events than those with clinically diagnosed ischemia, patients with this illness require a proactive approach to diagnosis and treatment. Silent ischemia is a powerful indicator of death. It is possible to experience a heart attack without even realizing it. Silent myocardial infarctions (SMIs), which make up 45% of heart attacks, are more common in males than in women [10]. The reason they are called "silent" attacks is that they don't often elicit the same severe symptoms as a traditional heart attack, like sudden shortness of breath, acute chest pain and pressure, stabbing pain in the arm, neck, or jaw, perspiration, and disorientation. "SMI symptoms can feel so mild, and be so brief, they often get confused for regular discomfort, or another less serious problem, and thus men ignore them," In some cases, a person may experience indigestion and nausea without classic heart attack symptoms like chest pain or shortness of breath. This can lead to delays in treatment as the obstruction of blood flow causes damage to the heart. A silent heart attack is more common than many people think, accounting for around 107,000 of the estimated 805,000

heart attacks in the United States each year [11].

1.1 Understanding Silent Heart Attacks

A silent heart attack is characterized by minimal or no symptoms, making it difficult to recognize without medical testing. Despite the lack of symptoms, silent heart attacks can cause significant damage to the heart muscle, similar to traditional heart attacks. Common signs, if they occur, may include mild discomfort, fatigue, or a feeling of indigestion, which are often overlooked or attributed to less severe causes. A silent heart attack, or silent myocardial infarction (SMI), is a type of heart attack that occurs without the classic, intense symptoms typically associated with myocardial infarctions. Unlike a traditional heart attack, which presents with severe chest pain, shortness of breath, and other noticeable symptoms, a silent heart attack manifests with minimal or no symptoms at all. This lack of obvious indicators can make silent heart attacks particularly dangerous, as they often go unnoticed and untreated, leading to significant heart damage over time [12].

2. ETIOLOGY

The most frequent causes of silent myocardial ischemia include rupture of the atherosclerotic plaque, coronary vasospasm, coronary vasculitis, trauma, coronary embolism, supply-demand mismatch, and sympathomimetic medications like cocaine [13]. The causal relationship is significantly influenced by the related risk variables. The subsequent risk factors are relevant to the development of silent myocardial ischemia and enhance vulnerability to asymptomatic ischemic episodes:

Diabetes Mellitus (DM): Diabetes mellitus (DM) is associated with an increased risk of silent myocardial ischemia and is a substantial risk factor for CAD. Patients with DM are most affected by cardiac autonomic dysfunction, which affects higher brain regions, afferent neurons, and pain receptors [4,9]. Research has indicated that in individuals with diabetes mellitus, atherogenic dyslipidemia is substantially associated with a higher risk of silent myocardial ischemia and CAD [14,13].

Perioperative Myocardial Infarction: The incidence of perioperative myocardial infarction is comparatively high in the elderly population. Research has indicated that individuals

undergoing coronary artery bypass grafting (CABG) experienced silent myocardial ischemia events that were picked up by Holter monitoring. Silent myocardial ischemia that occurs during surgery is typically asymptomatic. Therefore, it is advised to check your ECG throughout this time. The likelihood of perioperative myocardial infarction is increased by risk factors such as peripheral arterial disease and a history of myocardial infarction [15].

Older Patients: Silent myocardial ischemia is more common in older people. According to a study, 11.4% of 678 healthy men and women without a history of atherosclerotic cardiovascular disease had silent myocardial ischemia, which was identified by Holter monitoring. When other risk variables were taken into account, silent ischemia in this group of individuals was linked to a threefold increased risk of adverse cardiovascular events.

Other health issues can put you at a higher risk for a heart attack [16]. These include:

- Being overweight.
- Not exercising regularly.
- Having high blood pressure.
- Having high cholesterol.
- Eating a lot of foods that have cholesterol, salt and unhealthy fats in them.
- Having high blood sugar.
- Feeling stressed.
- Using tobacco.

Some things put you at a higher risk of a heart attack, but you can't change them. These include:

- Having a history of heart disease in your family.
- Having preeclampsia during pregnancy.
- Being older than 45 (males).
- Being postmenopausal or older than 55 (females).
- Being infected with COVID-19.

Symptoms: There are also cases of silent ischemia, or myocardial ischemia, in which there are no symptoms at all. Angina pectoris, or chest pressure or pain, usually affects the left side of the body, is the most common symptom when they do develop. Additional indications and symptoms that women, the elderly, and those with diabetes may suffer more frequently include as follows: [17]

- Jaw or neck ache
- Arm or shoulder pain
- An accelerated heart rate
- Breathing difficulties with vigorous activity
- Vomiting and nausea
- Fatigue with Sweating

2.1 Mechanisms of Silent Heart Attacks in COVID-19 Patients

COVID-19 has been associated with numerous complications, including a significant impact on cardiovascular health. Silent heart attacks, or silent myocardial infarctions (SMIs), present a unique challenge as they occur without obvious symptoms, making them particularly dangerous in the context of COVID-19. Understanding the mechanisms through which COVID-19 precipitates silent heart attacks is crucial for effective management and prevention [18]

2.2 Key Mechanisms

2.2.1 Direct viral infection and myocardial damage

- **SARS-CoV-2 Infection:** The virus can directly infect myocardial cells via the angiotensin-converting enzyme 2 (ACE2) receptors present on the heart's surface. This can lead to myocarditis, an inflammation of the heart muscle, causing damage without overt symptoms.
- **Cardiac Dysfunction:** The direct viral infection can lead to a decrease in myocardial function, contributing to silent ischemic events.

2.2.2 Systemic inflammatory response

- **Cytokine Storm:** COVID-19 can trigger a hyper inflammatory state known as a cytokine storm, where excessive cytokines (proteins involved in inflammation) are released into the bloodstream. This intense inflammatory response can damage the heart muscle, leading to silent myocardial injury.
- **Endothelial Dysfunction:** Inflammation can damage the endothelial cells lining the blood vessels, impairing vascular function and promoting atherosclerotic plaque instability and rupture, which can result in silent heart attacks [16]

2.2.3 Increased coagulopathy and thrombosis

- **Hypercoagulable State:** COVID-19 is associated with a Hypercoagulable state,

meaning the blood has an increased tendency to clot. Elevated levels of clotting factors and platelets can lead to the formation of micro thrombi in the coronary arteries.

- **Micro vascular Thrombosis:** The formation of small clots in the microvasculature of the heart can restrict blood flow without causing the severe symptoms typically associated with a heart attack, leading to silent ischemic events.

2.2.4 Hypoxia and oxygen supply-demand mismatch

- **Respiratory Complications:** Severe COVID-19 often leads to acute respiratory distress syndrome (ARDS) or other respiratory complications, resulting in hypoxia (low oxygen levels). Hypoxia can exacerbate ischemic conditions in the heart, particularly in patients with pre-existing cardiovascular conditions.
- **Increased Cardiac Workload:** The heart must work harder to pump blood in hypoxic conditions, increasing myocardial oxygen demand. If the supply cannot meet this demand, it can result in silent myocardial ischemia.

2.2.5 Autonomic Nervous System Imbalance

- **Autonomic Dysfunction:** COVID-19 can affect the autonomic nervous system, which regulates involuntary bodily functions, including heart rate and blood pressure. Dysregulation can lead to an imbalance in the supply of oxygen to the heart, potentially causing silent ischemic events.
- **Masked Symptoms:** Autonomic dysfunction may also interfere with the transmission of pain signals, masking the typical symptoms of a heart attack.

2.2.6 Stress and Psychological Factors

- **Psychological Stress:** The stress associated with the COVID-19 pandemic, including anxiety and depression, can increase cardiovascular strain. Psychological stress is known to exacerbate heart conditions and may contribute to the occurrence of silent heart attacks [15.6].

2.3 COVID-19 and Cardiovascular Health

COVID-19 has been found to have a profound effect on cardiovascular health. The virus can cause direct damage to the heart muscle, exacerbate pre-existing cardiovascular conditions, and increase the risk of blood clots. The mechanisms through which COVID-19 affects the heart include:

1. **Direct Viral Infection:** SARS-CoV-2 can directly infect myocardial cells, leading to myocarditis and subsequent cardiac dysfunction.
2. **Inflammatory Response:** The body's immune response to the virus can lead to widespread inflammation, affecting the heart and blood vessels.
3. **Thrombotic Complications:** COVID-19 is associated with an increased risk of thrombosis, which can result in heart attacks, strokes, and pulmonary embolisms.

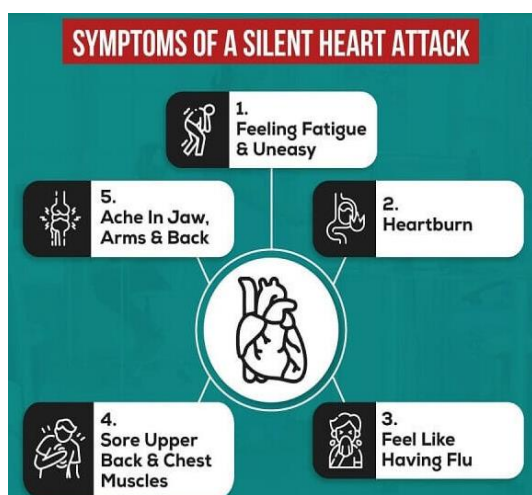


Fig. 1. Symptoms of SHA

2.4 The Link between Silent Heart Attacks and COVID-19

The COVID-19 pandemic has not only presented challenges related to respiratory illness but has also revealed intricate connections between the virus and cardiovascular health. Silent heart attacks, a condition characterized by myocardial infarctions occurring without typical symptoms, have emerged as a significant concern in COVID-19 patients. Understanding the relationship between silent heart attacks and

COVID-19 is crucial for effective management and prevention of cardiovascular complications in individuals affected by the virus. The interplay between silent heart attacks and COVID-19 is multifaceted. COVID-19 can increase the risk of a silent heart attack through several pathways: [14]

1. **Increased Cardiovascular Strain:** The systemic inflammation and increased metabolic demands caused by COVID-19 can strain the cardiovascular system, potentially leading to a silent heart attack, especially in individuals with underlying heart disease.
2. **Hypoxia:** Severe COVID-19 can cause low oxygen levels (hypoxia), which can stress the heart and lead to ischemic events.
3. **Coagulopathy:** COVID-19-associated coagulopathy increases the risk of coronary artery blockages, which can result in silent heart attacks.

2.5 Detection Challenges

The detection of silent heart attacks in COVID-19 patients is challenging due to the overlapping symptoms of both conditions. Many COVID-19 symptoms, such as fatigue, shortness of breath, and chest discomfort, can mask the subtle signs of a silent heart attack. Routine cardiac monitoring and the use of biomarkers (like troponin) and imaging techniques (such as ECG and echocardiography) are essential for detecting silent myocardial damage in COVID-19 patients [19].

2.6 Diagnostic Challenges: Detecting Silent Heart Attacks in COVID-19 Patients

Detecting silent heart attacks in COVID-19 patients presents a multifaceted challenge due to several factors unique to the intersection of these two conditions. Silent heart attacks, characterized by minimal or no symptoms, are particularly insidious in the context of COVID-19, where respiratory symptoms often overshadow cardiac manifestations. Understanding the diagnostic challenges is crucial for improving the detection and management of silent myocardial infarctions in COVID-19 patients.

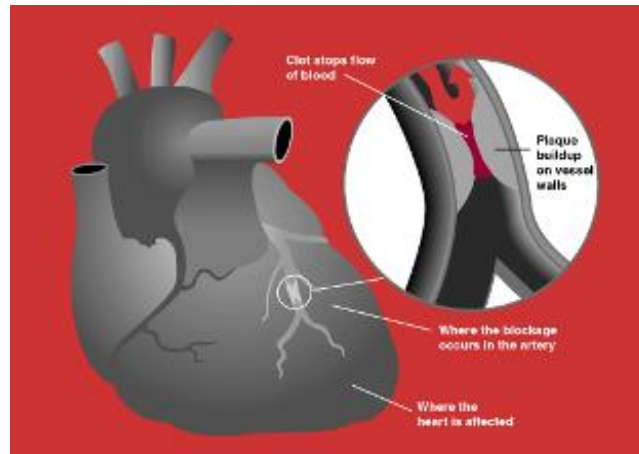


Fig. 3. Detection of MI

2.7 Overlapping Symptoms

The symptoms of COVID-19, such as fatigue, shortness of breath, and chest discomfort, can overlap with those of silent heart attacks, complicating diagnosis. Patients may attribute these symptoms to their respiratory illness, delaying recognition of underlying cardiac pathology. Distinguishing between COVID-19-related symptoms and those indicative of silent myocardial infarctions requires a high index of suspicion and thorough clinical evaluation [12].

2.8 Limited Clinical Evaluation Resources

Overwhelmed healthcare systems during the COVID-19 pandemic may face limitations in conducting comprehensive clinical evaluations, including cardiac assessments. Healthcare providers may prioritize the management of respiratory complications, leading to underutilization of cardiac diagnostic modalities. Limited access to specialized cardiac testing, such as electrocardiograms (ECGs) and cardiac biomarker assays, further impedes the timely detection of silent heart attacks in COVID-19 patients [9].

2.9 Delayed Presentation and Healthcare Utilization

COVID-19 patients may delay seeking medical attention for non-respiratory symptoms due to concerns about virus transmission or healthcare resource constraints. Fear of contracting COVID-19 in healthcare settings may deter patients from presenting with atypical symptoms suggestive of silent myocardial infarctions. Delays in

healthcare utilization prolong the time to diagnosis and treatment initiation, exacerbating the impact of silent heart attacks on patient outcomes [20].

2.10 Masked Findings

Electrocardiographic

Electrocardiography (ECG) is a cornerstone of diagnosing acute myocardial infarctions, but the interpretation of ECG findings in COVID-19 patients can be challenging. COVID-19-related electrolyte imbalances, myocardial injury, and concomitant medications may obscure ECG changes indicative of ischemia. Subtle or transient ECG abnormalities associated with silent heart attacks may be overlooked, leading to diagnostic uncertainty.

2.11 Imaging Limitations and Safety Concerns

Advanced cardiac imaging modalities, such as cardiac magnetic resonance imaging (MRI) and coronary angiography, play a crucial role in confirming the diagnosis of silent heart attacks. However, the use of these imaging techniques may be limited in COVID-19 patients due to safety concerns, resource constraints, and logistical challenges. Balancing the need for diagnostic certainty with the risks of exposure to healthcare personnel and transmission of COVID-19 presents a significant dilemma in clinical practice. Detecting silent heart attacks in COVID-19 patients requires a nuanced approach that considers the overlapping symptoms, resource limitations, delayed healthcare utilization, and interpretational challenges associated with cardiac diagnostic modalities.

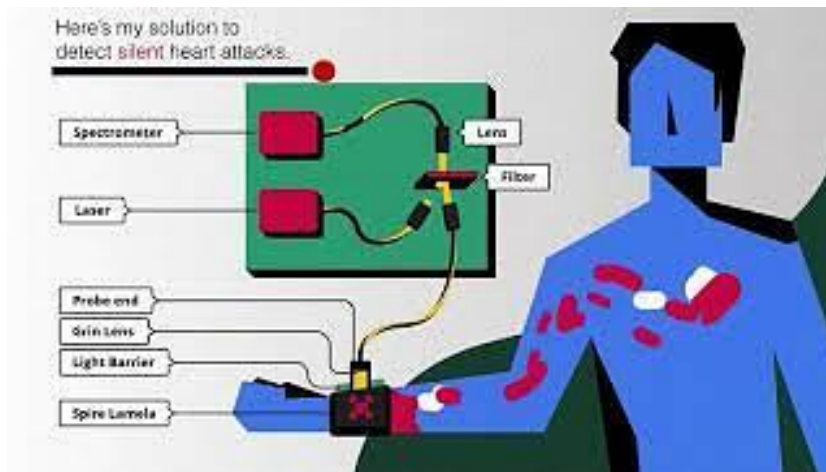


Fig. 4. Detection of SHA

Healthcare providers must maintain a high level of clinical suspicion for silent myocardial infarctions, particularly in COVID-19 patients with underlying cardiovascular risk factors or atypical symptoms. Integrating comprehensive cardiac assessments into the management algorithms for COVID-19 is essential for identifying and addressing silent heart attacks promptly, thereby optimizing patient outcomes and reducing the burden of cardiovascular morbidity and mortality associated with the pandemic [8].

3. IMPACT ON OUTCOMES

The presence of a silent heart attack in COVID-19 patients significantly worsens their prognosis. Studies have shown that COVID-19 patients with underlying cardiovascular damage or silent heart attacks have higher mortality rates and are more likely to experience severe complications. The dual burden of managing COVID-19 and a compromised heart function can overwhelm the body's compensatory mechanisms, leading to rapid clinical deterioration. Silent heart attacks, characterized by myocardial infarctions occurring without typical symptoms, represent a significant complication in COVID-19 patients. The interplay between these two conditions can have profound implications for patient outcomes, exacerbating the already complex clinical course of COVID-19. Understanding the impact of silent heart attacks on outcomes in COVID-19 patients is essential for optimizing management strategies and improving patient care.

Increased Mortality Risk: Silent heart attacks significantly increase the risk of mortality in

COVID-19 patients. The presence of underlying cardiovascular disease or myocardial injury is associated with a higher likelihood of adverse outcomes, including death. COVID-19 patients with silent myocardial infarctions have been shown to have a greater mortality rate compared to those without cardiac complications. The combination of respiratory compromise and cardiovascular compromise places these patients at heightened risk of poor outcomes [11].

Exacerbation of Respiratory Illness: Silent heart attacks can exacerbate respiratory compromise in COVID-19 patients, leading to prolonged hospitalization and increased risk of mechanical ventilation. The additional burden on the cardiovascular system, resulting from myocardial ischemia and dysfunction, can further compromise oxygen delivery to vital organs, including the lungs. This exacerbation of respiratory illness complicates the clinical management of COVID-19 patients and increases the likelihood of adverse outcomes, including respiratory failure and acute respiratory distress syndrome (ARDS).

Long-Term Cardiovascular Sequelae: Survivors of COVID-19 with silent myocardial infarctions may experience long-term cardiovascular complications, contributing to chronic morbidity and mortality. Silent heart attacks can lead to myocardial scarring, ventricular remodeling, and impaired cardiac function, predisposing patients to heart failure, arrhythmias, and recurrent ischemic events. The cumulative impact of COVID-19-related myocardial injury and subsequent cardiovascular Sequelae can significantly diminish the quality of life and functional status of affected individuals,

necessitating comprehensive cardiac rehabilitation and long-term follow-up care [17]

Diagnostic and Therapeutic Challenges: The silent nature of myocardial infarctions in COVID-19 patients poses diagnostic and therapeutic challenges, further complicating the management of these individuals. Delayed recognition of silent heart attacks may result in missed opportunities for timely intervention and secondary prevention measures. Additionally, the concomitant use of medications for COVID-19 management, such as anticoagulants and anti-inflammatory agents, may interact with traditional cardiovascular therapies, necessitating careful consideration of drug-drug interactions and adverse effects. Silent heart attacks in COVID-19 patients have a profound impact on outcomes, increasing mortality risk, exacerbating respiratory illness, and contributing to long-term cardiovascular morbidity. Early recognition, aggressive management, and comprehensive cardiac rehabilitation are essential for mitigating the adverse consequences of silent myocardial infarctions in this vulnerable population. Integrated multidisciplinary care, including close collaboration between cardiologists, pulmonologists, and critical care specialists, is essential for optimizing outcomes and improving the overall prognosis of COVID-19 patients with silent heart attacks [6]

3.1 Management and Prevention

Acute Management: Early Recognition: Despite the absence of typical symptoms, healthcare providers must maintain a high index of suspicion for silent heart attacks in COVID-19 patients, especially those with known cardiovascular risk factors or elevated cardiac biomarkers. Prompt recognition and diagnosis facilitate timely intervention and minimize myocardial damage.

Aggressive Treatment: Once diagnosed, silent heart attacks in COVID-19 patients should be managed with standard acute coronary syndrome protocols, including antiplatelet therapy, anticoagulation, and revascularization as indicated. Percutaneous Coronary Intervention (PCI) or thrombolytic therapy may be necessary to restore coronary blood flow and salvage myocardial tissue.

Optimization of COVID-19 Management: Concurrent management of COVID-19 is essential to mitigate the systemic inflammatory response and reduce the risk of myocardial

injury. This includes supportive care measures, such as oxygen therapy, ventilation support, and administration of antiviral or anti-inflammatory agents, tailored to the individual patient's clinical status.

3.2 Long-Term Prevention

Risk Factor Modification: Addressing modifiable cardiovascular risk factors is paramount in preventing recurrent silent heart attacks and mitigating the progression of underlying atherosclerotic disease. Lifestyle modifications, including smoking cessation, regular exercise, and adoption of a heart-healthy diet, should be emphasized to reduce the burden of traditional risk factors.

Medication Optimization: Optimal pharmacological therapy, including statins, antiplatelet agents, beta-blockers, and angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, is crucial for secondary prevention of cardiovascular events in COVID-19 patients with silent heart attacks. Close monitoring for drug interactions and adverse effects is essential, particularly in the context of COVID-19 treatments.

Cardiac Rehabilitation: Participation in structured cardiac rehabilitation programs can improve cardiovascular fitness, reduce mortality, and enhance quality of life in COVID-19 patients recovering from silent myocardial infarctions. These programs typically incorporate exercise training, risk factor education, psychosocial support, and medical management under the supervision of multidisciplinary healthcare teams [21].

Regular Follow-Up: Long-term surveillance and monitoring are essential for detecting recurrent ischemic events, assessing cardiac function, and optimizing medication regimens in COVID-19 patients with a history of silent heart attacks. Scheduled follow-up visits with cardiologists and primary care providers facilitate ongoing risk assessment and management, allowing for timely intervention if complications arise.

3.3 Education and Empowerment

Patient Education: Empowering COVID-19 patients with knowledge about the signs and symptoms of silent heart attacks, as well as the importance of adherence to prescribed medications and lifestyle modifications,

enhances self-management and facilitates early recognition of recurrent ischemic events.

Caregiver Education: Educating caregivers and family members about the unique challenges and management strategies for silent heart attacks in COVID-19 patients promotes a supportive care environment and facilitates adherence to treatment plans. Effective management and prevention of silent heart attacks in COVID-19 patients require a multifaceted approach that addresses acute myocardial injury, underlying cardiovascular risk factors, and long-term rehabilitation needs. By integrating acute management strategies with comprehensive secondary prevention measures and patient education initiatives, healthcare providers can optimize outcomes and reduce the burden of cardiovascular morbidity and mortality in this vulnerable population. Collaboration between cardiologists, infectious disease specialists, primary care providers, and allied healthcare professionals is essential to deliver holistic care and support COVID-19 patients on their journey to recovery.

3.4 Managing the Risk of Silent Heart Attacks in COVID-19 Patients Involves a Comprehensive Approach

1. **Regular Monitoring:** COVID-19 patients, especially those with known cardiovascular risk factors, should undergo regular cardiac monitoring to detect any signs of myocardial injury early.
2. **Use of Anticoagulants:** Prophylactic anticoagulation therapy can reduce the risk of thrombotic events, which are a significant contributor to silent heart attacks in COVID-19 patients.
3. **Anti-inflammatory Treatments:** Managing systemic inflammation with appropriate therapies can help mitigate cardiovascular strain.
4. **Rehabilitation and Follow-Up:** Post-COVID-19 rehabilitation should include cardiovascular assessment and management to address any lingering effects of silent heart attacks.[16]

4. DISCUSSION

The intersection of silent heart attacks and COVID-19 represents a complex and challenging scenario in clinical medicine. Silent heart attacks, characterized by myocardial infarctions occurring without typical symptoms, pose a significant

threat to the cardiovascular health of COVID-19 patients. This discussion will delve into the various aspects surrounding the management and prevention of silent heart attacks in individuals affected by COVID-19, considering the unique diagnostic challenges, therapeutic considerations, and long-term implications. One of the primary challenges in managing silent heart attacks in COVID-19 patients lies in the recognition and diagnosis of these events. The insidious nature of silent heart attacks, coupled with the overlapping symptoms of COVID-19, complicates early detection. Healthcare providers must maintain a high index of suspicion for silent myocardial infarctions, particularly in COVID-19 patients with pre-existing cardiovascular risk factors or elevated cardiac biomarkers. Implementing comprehensive diagnostic protocols, including electrocardiography, cardiac biomarker assays, and advanced imaging modalities, is essential for accurate diagnosis and timely intervention. Once diagnosed, the acute management of silent heart attacks in COVID-19 patients follows standard protocols for acute coronary syndrome, including antiplatelet therapy, anticoagulation, and revascularization as indicated. However, the concurrent management of COVID-19 presents additional challenges, as systemic inflammation and respiratory compromise can exacerbate myocardial injury. Optimal pharmacological therapy and supportive care measures tailored to the individual patient's clinical status are essential for mitigating the systemic effects of COVID-19 and minimizing myocardial damage [5].

Long-term prevention of recurrent silent heart attacks in COVID-19 patients requires a multifaceted approach that addresses modifiable cardiovascular risk factors and promotes cardiac rehabilitation. Lifestyle modifications, including smoking cessation, regular exercise, and adherence to a heart-healthy diet, play a crucial role in reducing the burden of atherosclerotic disease and preventing future ischemic events. Pharmacological therapy, such as statins and antiplatelet agents, is essential for secondary prevention, while structured cardiac rehabilitation programs provide ongoing support and education for patients recovering from silent myocardial infarctions. Patient education and empowerment are integral components of effective management and prevention strategies for silent heart attacks in COVID-19 patients. Empowering patients with knowledge about the signs and symptoms of silent heart attacks, as

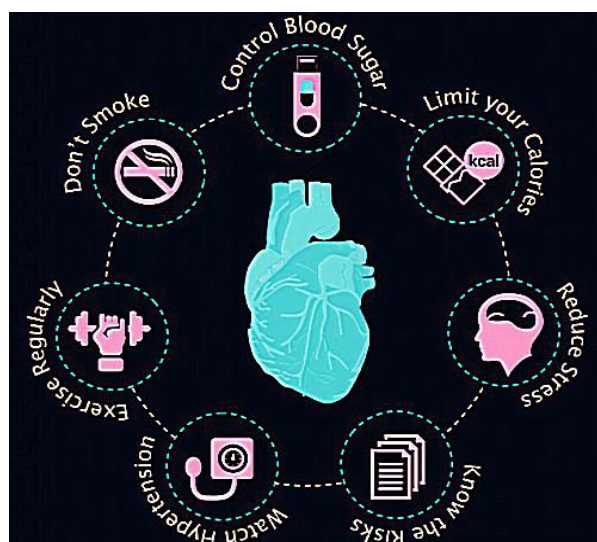


Fig. 5. Prevention of recurrent silent heart attacks

well as the importance of medication adherence and lifestyle modifications, enhances self-management and facilitates early recognition of recurrent ischemic events. Caregiver education is equally important, as it promotes a supportive care environment and fosters collaboration between patients, caregivers, and healthcare providers. In conclusion, the management and prevention of silent heart attacks in COVID-19 patients require a comprehensive and multidisciplinary approach that addresses acute myocardial injury, underlying cardiovascular risk factors, and long-term rehabilitation needs. By integrating acute management strategies with comprehensive secondary prevention measures and patient education initiatives, healthcare providers can optimize outcomes and reduce the burden of cardiovascular morbidity and mortality in this vulnerable population. Collaboration between cardiologists, infectious disease specialists, primary care providers, and allied healthcare professionals is essential to deliver holistic care and support COVID-19 patients on their journey to recovery [11,22,16,23-25],

5. CONCLUSION

In conclusion, the intersection of silent heart attacks and COVID-19 presents a formidable challenge in clinical medicine, demanding a nuanced and multidisciplinary approach to management and prevention. Silent heart attacks, characterized by myocardial infarctions occurring without typical symptoms, are particularly insidious in the context of COVID-19, where respiratory symptoms often overshadow

cardiac manifestations. The diagnostic challenges associated with silent heart attacks in COVID-19 patients underscore the importance of maintaining a high index of suspicion and implementing comprehensive diagnostic protocols to ensure timely recognition and intervention. Acute management strategies, including aggressive treatment of acute coronary syndrome and optimization of COVID-19 management, are essential for minimizing myocardial damage and reducing mortality risk. Long-term prevention of recurrent silent heart attacks requires a holistic approach that addresses modifiable cardiovascular risk factors, promotes pharmacological therapy, and facilitates participation in structured cardiac rehabilitation programs. Patient education and empowerment play a pivotal role in enhancing self-management and facilitating early recognition of recurrent ischemic events, while caregiver education fosters collaboration and support within the care environment.

In navigating the complex landscape of silent heart attacks in COVID-19 patients, collaboration between cardiologists, infectious disease specialists, primary care providers, and allied healthcare professionals is paramount. By integrating acute management strategies with comprehensive secondary prevention measures and patient education initiatives, healthcare providers can optimize outcomes and mitigate the long-term cardiovascular sequelae of COVID-19 in this vulnerable population. Ultimately, the successful management and prevention of silent heart attacks in COVID-19 patients hinge on

proactive surveillance, timely intervention, and ongoing support for patients on their journey to recovery. Through collective efforts and a commitment to holistic care, healthcare providers can make significant strides in mitigating the impact of silent heart attacks and improving the overall prognosis of COVID-19 patients affected by cardiovascular complications. Silent heart attacks represent a significant and often overlooked complication in COVID-19 patients. The insidious nature of these events necessitates vigilant monitoring and a proactive approach to cardiovascular care in individuals affected by COVID-19. By understanding and addressing the risks, healthcare providers can improve outcomes and reduce the long-term impact on survivors' health. As research continues, a deeper understanding of the relationship between silent heart attacks and COVID-19 will guide more effective strategies for prevention and treatment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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