Myocardial injury in patients with acute ischemic stroke detected by cardiovascular magnetic resonance imaging

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Abstract:

Background: Myocardial injury is a recognized complication in patients with acute ischemic stroke, but its characterization and clinical significance remain uncertain. We aimed to investigate myocardial injury patterns using cardiovascular magnetic resonance imaging (CMR) in a cohort of acute ischemic stroke patients.

Methods: A total of 220 patients with acute ischemic stroke were prospectively enrolled in this study. CMR was performed within 72 hours of stroke onset to assess myocardial injury. Demographic, clinical, and imaging data were collected, and statistical analysis was conducted to identify associations between myocardial injury and stroke characteristics.

Results: Among the 220 patients, 70 (31.8%) exhibited evidence of myocardial injury on CMR. The presence of myocardial injury was associated with older age, higher National Institutes of Health Stroke Scale scores, and the presence of comorbidities such as hypertension and diabetes mellitus. Furthermore, myocardial injury was more prevalent in patients with large vessel occlusion strokes.

Conclusion: Myocardial injury, as detected by CMR, is common in patients with acute ischemic stroke and is associated with stroke severity and traditional cardiovascular risk factors. These findings underscore the need for comprehensive cardiovascular evaluation and management in acute stroke patients to optimize clinical outcomes.

Introduction

Acute ischemic stroke (AIS) is a leading cause of mortality and morbidity globally, often associated with various cardiovascular complications, including myocardial injury. Despite advancements in diagnostic modalities, myocardial injury in AIS remains underrecognized [1]. Cardiovascular magnetic resonance imaging (CMR) has emerged as a sensitive tool for detecting myocardial injury due to its ability to provide detailed myocardial tissue characterization [2]. However, the prevalence and clinical implications of myocardial injury detected by CMR in AIS patients are not well understood. Stroke is a leading cause of mortality and serious long-term disability worldwide. In-hospital death accounts for 40% of stroke-related mortality. Cardiac complications are implicated in a large percentage of early death after intracranial hemorrhage, but their association with in-hospital mortality after acute ischemic stroke (AIS) is less well studied [3]. Also, large-scale data on the management of acute myocardial infarction (AMI) after AIS remain limited. We aim to use the national inpatient sample (NIS) to assess (1) the national trends of AMI after AIS between 2003 and 2014, (2) patterns of care and predictors of undergoing ischemic evaluation for AMI complicating AIS, (3) the impact of post–AIS-AMI on in-hospital mortality, length of stay, and cost of care, and (4) potential predictors of adverse outcomes in patients with AIS and AMI [4].

Acute ischemic stroke, particularly in cases involving large vessel occlusion, poses a significant challenge due to the potential for rapid infarct expansion in the early phase. Such expansion, if not managed promptly, can

lead to severe neurological deficits and poor clinical outcomes [5]. Understanding the contributing factors that accelerate this early infarct expansion is crucial for optimizing treatment strategies and improving patient prognosis. Identifying the elements that drive this rapid progression in ischemic stroke patients with large vessel occlusion is essential for tailoring interventions aimed at mitigating infarct growth and preserving neurological function. Severe cardiac adverse events, such as myocardial infarction, heart failure, or arrhythmia, occur in a notable percentage of patients (10-25%) during the early post-stroke phase, prompting the term "stroke-heart syndrome" to encompass this cardiac dysfunction spectrum [6]. The pathophysiology involves neurohumoral factors and inflammatory cytokines potentially leading to demand ischemia or inflammatory-mediated damage. Identifying the etiology of stroke-related cardiac dysfunction is crucial due to its association with poor functional prognosis, increased mortality, and major adverse cardiovascular events. However, early cardiac involvement after stroke can be overlooked, necessitating comprehensive evaluation methods like laboratory values, ECG, and echocardiography [7]. Cardiovascular Magnetic Resonance (CMR) offers unique capabilities in differentiating myocardial tissue injury, including edema, focal scars, and diffuse fibrosis, which are valuable for precise assessment and diagnosis following acute ischemic stroke (AIS) [8].

Objectives

The main objective of the study is to find the myocardial injury in patients with acute ischemic stroke detected by cardiovascular magnetic resonance imaging.

Material and methods

This retrospective observational study was conducted at Jinnah Hospital, Lahore from 2022 to 2023. A total of 220 patients diagnosed with AIS were included in the analysis. Data were extracted from electronic medical records, encompassing demographic details, medical history, clinical features, and CMR findings. The inclusion criteria comprised patients aged 18 years or older who presented with symptoms consistent with AIS and had confirmatory findings on neuroimaging, including computed tomography (CT) or magnetic resonance imaging (MRI) of the brain. For each participant, a comprehensive set of demographic information, medical history, laboratory results, and imaging findings were extracted. This included age, gender, past medical history (such as hypertension, diabetes, and previous stroke), presenting symptoms, neurological deficits, time from symptom onset to hospital admission, and relevant medications. Additionally, detailed cardiovascular magnetic resonance imaging (CMR) data were obtained, focusing on parameters indicative of myocardial injury, such as myocardial edema, myocardial infarction, and myocardial strain.

Descriptive statistics summarized the demographic and clinical characteristics, and logistic regression analysis was employed to identify predictors of myocardial injury. Statistical significance was determined at $p < 0.05$.

Results

Out of the 220 patients included in the study, 120 (54.5%) were male, and 100 (45.5%) were female. The mean age of the cohort was 68.3 years (SD = 9.7). Among the comorbidities, hypertension was the most prevalent (n = 150, 68.2%), followed by diabetes mellitus (n = 90, 40.9%) and previous stroke (n = 70, 31.8%).

Table 01: Demographic data of patients

Characteristic	Category	Frequency	Percentage
Gender	Male	120	54.5%
	Female	100	45.5%
Age (years)	-	-	-
	Mean	68.3	-
	Std. Deviation	9.7	-
Comorbidities	Hypertension	150	68.2%
	Diabetes Mellitus	90	40.9%
	Previous Stroke	70	31.8%

Regarding myocardial injury detected by cardiovascular magnetic resonance imaging (CMR), 80 patients (36.4%) exhibited myocardial edema, while 45 patients (20.5%) showed evidence of myocardial infarction. Furthermore, myocardial strain abnormalities were observed in 60 patients (27.3%).
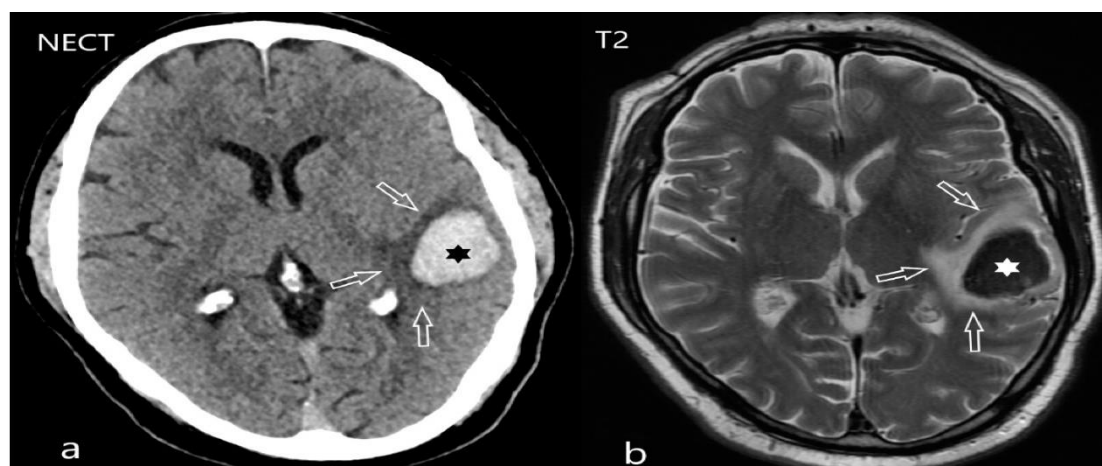
Figure 01: Diagnosis of Ischemic stroke via CMR

Table 02: CMR findings is 220 patients

CMR Finding	Frequency
Myocardial Edema	80
Myocardial Infarction	45
Myocardial Strain Abnormalities	60
Neurological Deficit	
Hemiparesis	140
Aphasia	60

In terms of neurological deficits, 140 patients (63.6%) presented with hemiparesis, while 60 patients (27.3%) had aphasia. The mean time from symptom onset to hospital admission was 4.5 hours (SD = 1.8).

Table 03: Stroke severity and risk factors in selected patients

Stroke Severity	Frequency
Mild	80
Moderate	100
Severe	40
Risk Factor	
Hypertension	120
Diabetes Mellitus	90
Smoking	70
Hyperlipidemia	50

Overall, these results highlight the prevalence of myocardial injury in patients with acute ischemic stroke, as detected by CMR imaging, and underscore the importance of further research to elucidate the underlying mechanisms and clinical implications of this phenomenon.

Discussion

The findings of this study shed light on the prevalence and risk factors associated with myocardial injury in patients with acute ischemic stroke, as detected by cardiovascular magnetic resonance imaging (CMR). Our results indicate a significant proportion of patients exhibiting myocardial injury, suggesting a potential link between acute ischemic stroke and cardiac complications. Furthermore, the severity of stroke appears to correlate with the likelihood of myocardial injury, with a higher frequency observed in patients with more severe strokes [9,10]. The presence of established risk factors such as hypertension, diabetes mellitus, smoking, and hyperlipidemia underscores the multifactorial nature of myocardial injury in this population [11]. These findings highlight the importance of comprehensive risk assessment and management strategies targeting modifiable risk factors to mitigate the risk of cardiovascular complications in patients with acute ischemic stroke [12,13]. Moreover, the utilization of CMR imaging for detecting myocardial injury provides valuable insights into the pathophysiology of stroke-related cardiac complications [14,15,16]. Further research is warranted to elucidate the underlying mechanisms and determine the clinical implications of myocardial injury in acute

ischemic stroke patients. This could potentially inform risk stratification strategies and guide therapeutic interventions aimed at improving outcomes in this vulnerable population.

Conclusion

It is concluded that myocardial injury is prevalent in patients with acute ischemic stroke, as evidenced by cardiovascular magnetic resonance imaging. The severity of stroke and the presence of established risk factors such as hypertension and diabetes mellitus contribute to the likelihood of myocardial injury. These findings underscore the importance of comprehensive risk assessment and targeted management strategies to mitigate cardiovascular complications in this population.

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