



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

myocardial infarction with nonobstructive coronary arteries (MINOCA); 4) aspiration thrombectomy use; and 5) no reflow phenomenon.

**RESULTS** Nine studies (6,664 patients) met the inclusion criteria. Patients with ACS and COVID-19 infection have 4.6 times and 3.8 times higher risk of in-hospital all-cause and cardiovascular mortality (RR 4.58, 95% CI 3.23 - 6.50,  $p < 0.001$ ) (RR 3.83, 95% CI 1.32 - 11.12,  $p = 0.01$ ), respectively, compared to patients without COVID-19. They also have a significantly high risk of cardiac arrest on presentation (RR 1.95, 95% CI 1.24 - 3.07,  $p = 0.004$ ). There was an elevated risk of requiring aspiration thrombectomy (RR 1.55, 95% CI 1.11 - 2.18,  $p = 0.01$ ) and no reflow (RR 2.28, 95% CI 1.37 - 3.77,  $p = 0.001$ ), along with higher risk of MINOCA (RR 2.49, 95% CI 1.31 - 4.72,  $p = 0.005$ ) in COVID-19 patients. Subgroup analysis of patients with STEMI also showed a significantly higher risk of in-hospital all-cause mortality, cardiac arrest on presentation, no reflow, and use of aspiration thrombectomy. Serum C-reactive protein (MD 65.33 mg/L, 95% CI 44.42 - 86.23,  $p < 0.001$ ) and D-dimer levels (MD 1.48 mg/L, 95% CI 0.65 - 2.31,  $p = 0.005$ ) were significantly higher in COVID-19 patients.

**CONCLUSIONS** Patients with ACS and COVID-19 have an increased risk of in-hospital all-cause and cardiovascular mortality, as well as higher risk of aspiration thrombectomy use, no reflow and MINOCA compared to no COVID-19 patients.

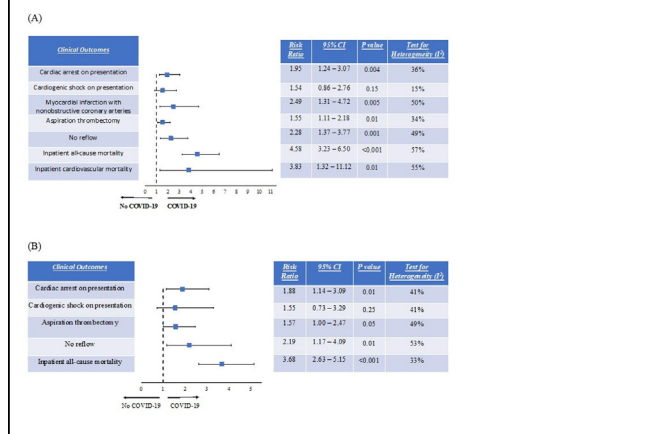
**BACKGROUND** The coronavirus disease of 2019 (COVID-19) is a global pandemic with over 200 million cases and four million deaths worldwide. Anti-COVID-19 vaccinations have had exceptional success in subduing the incidence, prevalence, and disease severity of COVID-19, but rare cases of myocarditis have been reported after COVID-19 vaccinations.

**METHODS** We performed a systematic literature search on PUBMED, MEDLINE, EMBASE, and Cochrane Reviews database from inception to July 18, 2021. Studies were analyzed based on predetermined eligibility criteria.

**RESULTS** A total of 19 studies containing 73 cases of COVID-19 vaccine-associated myocarditis were catalogued. Mean age was 25 years, and male to female ratio was 17:1. For 87.7% of patients, myocarditis occurred after the second dose. Average time to onset and length of hospitalization were 3.5 days and 5.2 days, respectively. Prognosis was benign with 100% recovery. Chest pain (100%); elevation of troponin (100%) and CRP (94.4%); and ST elevation on EKG (81.4%) were common. NSAIDs (73.5%) were the most used medication, followed by colchicine (50%).

**CONCLUSIONS** Patients with COVID-19 vaccine-associated myocarditis are usually younger males presenting with chest pain 3.5 days after receiving their second dose. Work-up typically shows elevation of troponin and CRP with ST changes in EKG. Diagnosis is made after excluding all other etiologies. Given significant population benefit from COVID-19 vaccination, physicians should continue to encourage vaccination while remaining vigilant of the very rare occurrence of myocarditis following COVID-19 vaccination.

Figure (A) Pooled analysis of outcomes in acute coronary syndrome among patients with coronavirus 2019 (COVID-19) vs. no COVID-19 infection (B) Pooled analysis of outcomes in ST-elevation myocardial infarction among patients with COVID-19 vs. no COVID-19 infection.



**CRT-200.09**

**Myocarditis After COVID-19 Vaccination: A Systematic Review of Case Studies**

Dae Yong Park,<sup>1</sup> Seokyoung An,<sup>2</sup> Saurabh Malhotra,<sup>1</sup> Aviral Vij<sup>1</sup>  
<sup>1</sup>John H. Stroger, Jr. Hospital of Cook County, Chicago, IL; <sup>2</sup>Seoul National University, Seoul, Korea, Republic of



Characteristics	N (%)	Laboratory and Testing Variables	N (%)	Treatment	N (%)
Age, mean (range), year	25.0 (14-70)	Troponin	25 (34.2)	NSAID	25 (34.2)
Sex		Elevated	29 (39.7)	Colchicine	17 (23.3)
Male	69 (94.5)	Not elevated	0	Statins	7 (9.6)
Female	4 (5.5)	Not reported	44 (60.3)	Beta-blocker	7 (9.6)
Vaccine type		cTnI, mean (SD), ng/mL	8.3 (8.7)	IVIG	6 (8.2)
BNF-1628	47 (64.4)	Peak cTnI, mean (SD), ng/mL	18.1 (13.3)	Aspirin	4 (5.5)
mRNA-1273	25 (34.2)	hs-cTnI, mean (SD), ng/mL	2.081 (2.459)	ACEi/ARB	3 (4.1)
Ad 26 COV2.S	1 (1.4)	Peak hs-cTnI, mean (SD), pg/mL	6.028 (2.098)	Acetaminophen	1 (1.4)
Vaccine dose		cTnI, mean (SD), ng/L	373.1 (463.5)	Diazepam	1 (1.4)
First	9 (12.3)	Peak cTnI, mean (SD), ng/L	658.1 (564.9)	Statins	1 (1.4)
Second	64 (87.7)	WBC	Not reported	Clotapogrel	1 (1.4)
Time to onset, mean (SD), day	3.5 (3.82)	Normal	15 (20.6)	Not reported	39 (53.4)
Length of stay, mean (SD), day	5.2 (11.00)	Abnormal	8 (10.9)		
Not reported	50 (68.5)	WBC count, mean (SD), /μL	8,987 (3,943)		
<b>Symptoms</b>	<b>N (%)</b>	CRP			
Fever		Elevated	34 (46.6)		
Yes	20 (27.4)	Not elevated	2 (2.6)		
No	20 (27.4)	Not reported	37 (50.7)		
Not reported	33 (45.2)	CRP mean (SD), mg/L	46.3 (41.0)		
Chest pain		ESK			
Yes	64 (87.7)	Elevated	14 (19.2)		
No	0	Not elevated	13 (17.8)		
Not reported	9 (12.3)	Not reported	46 (63.0)		
Chills		ESK, mean (SD), mm/h	16.6 (10.8)		
Yes	12 (16.4)	ESK			
No	52 (71.2)	Elevated	2 (2.7)		
Not reported	9 (12.3)	Not elevated	7 (9.6)		
Myalgia		Not reported	69 (97.7)		
Yes	12 (16.4)	BNP, mean (SD), pg/mL	71.2 (60.4)		
No	52 (71.2)	RKQ			
Not reported	9 (12.3)	Normal	3 (4.1)		
Headache		ST elevation	57 (78.1)		
Yes	7 (9.6)	ST depression	2 (2.7)		
No	57 (78.1)	PR depression	8 (11.0)		
Not reported	9 (12.3)	T wave inversion	27 (37.0)		
Dyspnea		Obese*	8 (11.0)		
Yes	7 (9.6)	Not reported	3 (4.1)		
No	57 (78.1)	<b>Vital Signs</b>			
Not reported	9 (12.3)	Temperature, °C			
<b>Vital Signs</b>	<b>Mean (SD)</b>	SBP, mmHg	119.8 (14.1)		
Temperature, °C		DBP, mmHg	71.6 (11.1)		
SBP, mmHg	119.8 (14.1)	PR, beats per minute	91.4 (18.5)		
DBP, mmHg	71.6 (11.1)	RR, beats per minute	18.0 (1.3)		
PR, beats per minute	91.4 (18.5)	SpO <sub>2</sub> , %	98.7 (1.32)		
RR, beats per minute	18.0 (1.3)				
SpO <sub>2</sub> , %	98.7 (1.32)				

Abbreviations: ACEi = angiotensin-converting enzyme inhibitor, ARB = angiotensin II receptor blocker, BNP = brain natriuretic peptide, CRP = c-reactive protein, cTnI = cardiac troponin I, cTnT = cardiac troponin T, DEB = diastolic blood pressure, EKG = electrocardiogram, ESK = erythrocyte sedimentation rate, hs-cTnI = high-sensitivity cardiac troponin I, IVIG = intravenous immunoglobulin, LVEF = left ventricular ejection fraction, NSAID = non-steroidal anti-inflammatory drug, PR = pulse rate, RR = respiratory rate, SBP = systolic blood pressure, SD = standard deviation, SpO<sub>2</sub> = pulse oximeter oxygen saturation, WBC = white blood cell