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Original Research

Racial and Ethnic Disparities in Acute Coronary Syndrome: A Nationally Representative Sample

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A B S T R A C T

Background: Disparities in acute coronary syndrome (ACS) outcomes exist between racial and ethnic groups. We aimed to evaluate disparities in resource utilization and inpatient outcomes across multiple ethnic and racial groups using contemporary data.

Methods: We identified hospital discharges for ACS in the United States using the National Inpatient Sample from 2015 to 2018. The *International Classification of Diseases, Tenth Revision, Clinical Modification* codes were used to identify variables of interest. The primary outcomes were in-hospital complications, length of stay, and total hospital charge. Statistical analysis was performed using STATA version 17.

Results: Our analysis included 1,911,869 ACS discharges. Our sample was made up of 78.6% White, 12.1% Black, and 9.3% Hispanic patients. Hispanic and Black patients presenting with ACS were younger and had more cardiometabolic comorbidities than their White counterparts, especially hypertension, diabetes mellitus, and obesity. Despite social determinants of health being more likely to be unfavorable for Hispanics than their White counterparts, they were more likely to incur higher total hospital charges than their White counterparts. Black patients were the least likely to undergo revascularization procedures. Despite these differences, White patients had higher in-hospital mortality rates than Black and Hispanic patients.

Conclusions: In this nationally representative study, despite having higher cardiometabolic comorbidity burden, lower socioeconomic status, and percutaneous intervention, Black and Hispanic patients experienced lower mortality rates than their White counterparts. Hispanic patients incurred the highest amount of total hospital charges for an ACS admission.

Introduction

A multitude of advances have been made in cardiovascular medicine in the last decade, but cardiovascular disease continues to be the number one cause of death in the United States.[1–3] Despite an overall reduction in acute coronary syndrome (ACS) incidence across all ethnicities and races, disparities exist in the rate of decline between these groups.[4–6] Disparities in cardiovascular disease outcomes exist between racial and ethnic groups for numerous patient, provider, and institutional factors.[7–13] Medical comorbidities are not evenly distributed, with coronary artery disease (CAD) risk factors such as hypertension, diabetes mellitus, hyperlipidemia, and insulin resistance more frequently diagnosed in racial/ethnic minorities than in their White counterparts.[14–16] Disparities in ACS and myocardial infarction (MI) have been observed in an analysis of data from major projects such as Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC/AHA Guidelines, Reasons for Geographic and Racial Differences in Stroke, and Get With The Guidelines - Coronary Artery Disease.[17–19]

Studies evaluating ACS in-hospital outcomes and resource utilization in this era of marked advancements in ACS management are limited. Highlighting disparities among different ethnic and racial groups can encourage further studies evaluating the source of these disparities and lead to policy changes addressing these discrepancies.

Therefore, we aimed to evaluate inpatient outcomes and resource utilization in patients admitted with ACS among non-Hispanic White

Abbreviations: ACS, acute coronary syndrome; AKI, acute kidney injury; CAD, coronary artery disease; NSTEMI, non–ST-elevation myocardial infarctions; STEMI, ST-elevation myocardial infarction.

Keywords: ACS; disparity; ethnicity; MI; race.

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(hereafter denoted as White), non-Hispanic Black (hereafter denoted as Black), and Hispanic patients using a nationally representative database with a large cohort of hospitalizations.

Materials and methods

Data source, study population, and outcomes

This is a retrospective analysis of hospital discharge data from the Health Care Utilization Project-Nationwide Inpatient Sample database between October 2015 and 2018. The National (Nationwide) Inpatient Sample (NIS) was developed by the Healthcare Cost and Utilization Project as a collection of databases to allow researchers and legislators to make educated decisions about health care quality, cost, and outcomes. Data from 2015 include information on 35 million hospitalizations. Data elements include the *International Classification of Diseases* codes, hospital characteristics, length of stay, total charges, and payer information. This database represents the largest inpatient database in the United States. The NIS represents a 20% stratified sampling of US hospitals, including public hospitals, children's hospitals, and academic medical centers. The sampling frame for the NIS is a sample of hospitals that comprises approximately 95% of all hospital discharges in the United States.

The *International Classification of Diseases, Tenth Revision* was used to identify all hospital discharges of adult patients in the NIS database between October 2015 and 2018 with primary diagnosis codes of ACS. The primary *International Classification of Diseases, Tenth Revision* diagnoses and procedure codes are shown in the Appendix. Racial subgroups of Whites, Blacks, and Hispanics were included, and other races were excluded.

We adjusted for the following covariates: age, residential income (median household income for the patient's zip code), insurance type, discharge year, geographic region, teaching status of hospitals, location of hospital (urban versus rural), hospital ownership, hospital bed size, hospital volume, stage, and type of surgical procedure. Residential income provided a quartile classification of the estimated median household income of residents in the patient's zip code. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Hospitals were classified as teaching or nonteaching hospitals by the presence of any residency program approved by the Accreditation Council for Graduate Medical Education or membership in the Council of Teaching Hospitals. Designation as an urban or rural hospital was according to census 2000 definitions of urban population (>50,000) or rural population (<50,000). Hospital bed size categories were defined based on the region of the United States and the urban-rural designation of the hospital, in addition to the teaching status.

Statistical analysis

Simple descriptive analyses such as counts and percentages were used to describe data. We examined the distribution of the aforementioned factors across races using the χ^2 test for the categorical variables and the t test for the continuous variables. The patient and hospital characteristics, as well as comorbidities, were obtained from a literature review. Multivariate regression analysis was performed to adjust for possible confounders while calculating the odds ratio (OR) and P value for the association of the Black population as a predictor of the outcomes of interest. A univariate screen was performed to further confirm these factors. Variables with a P value of <.2 in the univariate screen were included in our multivariable regression model. For all statistical analyses, the threshold for significance was 0.05. All the analysis was generated using STATA software, version 17, for Windows.

Results

We identified 1,911,869 discharges with a primary diagnosis of ACS. The general characteristics of the included patient populations are recorded in Table 1. Our sample was made up of 1,502,347 (78.6%) White, 232,101 (12.14%) Black, and 177,421 (9.28%) Hispanic patients. Most patients were men across different race categories; 943,023,212 (62.77%) were White, 125,079 (53.89%) were Black, and 111,225 (62.69%) were Hispanic. Black patients were significantly younger than the other racial groups.

Table 1 demonstrates past medical history among different subgroups. Prior MI (16.28%) and prior percutaneous coronary intervention (PCI) (10.77%) were more common in White patients. Hypertension was more common in Black patients (89.25%), but hyperlipidemia was less common (60.45%). Chronic kidney disease was more common in Black patients (33.07%), as were heart failure (40.35%) and obesity (21.61%). The ACS subtype was statistically different between groups: ST-elevation myocardial infarctions (STEMIs) were more prevalent in White patients than in Black and Hispanic patients. Non–ST-elevation myocardial infarctions (NSTEMIs) were significantly more prevalent in Black patients than in other race/ethnic groups. Black patients were the least to undergo revascularization among the 3 racial groups.

Table 2 demonstrates inpatient complications during hospitalization. Mortality rates were higher in White populations. However, respiratory failure requiring mechanical ventilation was higher in Black (2.88%) and Hispanic (2.96%) patients. Acute kidney injury (AKI) was higher in Black patients (23.74%). Circulatory shock not related to sepsis was higher in Hispanic patients (7.46%). Upper gastrointestinal bleeding (UGIB) was higher in Black patients (1.96%).

Table 3 discusses race as a risk factor in predicting inpatient outcomes. Identifying as Black as compared to other races as a risk factor was predictable of the need for mechanical ventilation (OR, 1.08; $P = .03$). When adjusted for other risk factors, the OR was 0.99 ($P = 0.77$), indicating it was not significant. Black as a race was predictive of developing AKI inpatient (OR, 1.33; $P < .05$). This significance remained when adjusting for other risk factors (OR, 1.12; $P < .001$).

Discussion

There were 4 prominent findings in our study evaluating racial and ethnic differences in those admitted with ACS: (1) Hispanic and Black patients presenting with ACS were younger and had higher cardiometabolic comorbidities than their White counterparts, (2) Hispanic patients incurred the highest total hospital charge despite having lower social determinants of health than White patients, (3) Black patients were the least likely to undergo revascularization procedures, and (4) White patients were more likely to present with a STEMI and had higher mortality rates than Black and Hispanic patients (Central Illustration).

Eliminating racial and ethnic disparities in patients with ACS is a national priority.[20] Studies weighing differences in health care utilization and outcomes can lead to policy changes that target these discrepancies. We need to continually re-evaluate with contemporary data whether disparities in the care of ACS continue to exist. The NIS provides a large, contemporary, real-world, nationally representative, multicenter, all-payer type, and multiracial/ethnic sample of patients with hundreds of variables that could be utilized to highlight racial and ethnic disparities in the United States. In this study, we highlighted the fundamental differences in resource utilization and in-hospital outcomes in ACS admissions across various racial and ethnic groups.

Most of our patients presenting with ACS were male, which was expected as the male sex is a nonmodifiable risk factor for acute MI.[21] In addition, our Black cohort presenting with ACS was more likely to be of a younger age group, as also noted in other studies.[17–22] Black and Hispanic patients were more likely to have comorbidities such as obesity, hypertension, chronic kidney disease (CKD), and diabetes mellitus with

Table 1. Baseline characteristics of admissions by racial/ethnic group.

	White (n = 1,502,347)	Black (n = 232,101)	Hispanic (n = 177,421)	*P* value
Male	62.77	53.89	62.69	<.001
Age, y	68.07	62.75	64.54	<.001
Quartile of median household income for zip code				
0-25th	26.86	54.25	39.03	<.001
26th-50th	29.19	21.51	26.04	
51st-75th	24.82	15.05	21.08	
75th-100th	19.13	9.19	13.85	
Insurance				
Medicare	62.33	53.49	50.11	<.001
Medicaid	7.06	17.26	17.48	
Private	26.72	22.30	23.92	
Others	3.89	6.94	8.49	
Region of the hospital				
Northeast	18.74	14.77	13.36	<.001
Midwest	24.78	19.28	6.04	
South	40.00	56.39	44.73	
West	16.48	9.55	35.87	
Bed size				
Small	17.18	16.95	16.87	.0008
Medium	30.21	31.55	34.53	
Large	52.61	51.50	48.60	
Hospital location				
Rural	9.51	5.11	2.07	<.001
Urban	90.49	94.89	97.93	
Hospital teaching				
0	34.50	23.61	28.55	<.001
1	65.50	76.39	71.45	
Past medical history				
Prior myocardial infarction	16.28	16.09	14.36	<.001
Hypertension	79.93	89.25	83.76	<.001
Hyperlipidemia	67.23	60.45	66.01	<.001
Chronic kidney disease	21.95	33.07	26.47	<.001
Diabetes with circulatory complications	2.79	3.75	4.42	<.001
Hypertensive CKD with heart failure	7.60	10.23	8.17	<.001
Heart failure	33.27	40.35	35.69	<.001
Obesity	19.05	21.61	19.93	<.001
Prior PCI	10.77	7.46	9.34	<.001
Prior CABG	1.54	1.61	1.54	.582
ACS type				
STEMI	27.04	20.37	25.71	<.001
NSTEMI	71.00	76.63	72.03	
Other	1.96	3.00	2.27	

Values are presented as %, unless otherwise specified.
ACS, acute coronary syndrome; CABG, coronary artery bypass graft; NSTEMI, non–ST-elevation myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction.

circulatory complications than our White cohort, similar to the findings reported in the literature.[14–16,23–26] The difference in the prevalence of comorbidities among Black and Hispanic patients compared with White patients could be explained by differences in lifestyle. For instance, Hispanic patients have been shown to be less active and less likely to meet physical activity recommendations than White patients.[26,27] Moreover, Black patients are also less likely to consume recommended dietary guidelines for fruits, vegetables, and whole grains, while consuming a higher percentage of calories from fast food than their White and Hispanic counterparts.[26,28] This could be related to discrepancies to access to healthy, affordable food options, where those of a minority group are more likely to live in "food deserts."[29–31]

Women presenting with ACS in the literature are known to experience worse in-hospital outcomes, and our Black population had the highest portion of women among the racial/ethnic groups.[21,32] Earlier studies have stark differences in how Black patients receive ACS care, including delays in door-to-balloon time and door-to-drug time, and they are less likely to receive PCI, angiography, drug-eluting stent, and coronary artery bypass grafting than White patients.[4,14,16,33] Our Black patients were also less likely to be revascularized with PCI and coronary artery bypass

Table 2. Inpatient outcomes and resource utilization during admission by race/ethnic group.

	White (n = 1,502,347)	Black (n = 232,101)	Hispanic (n = 177,421)	*P* value
In-hospital mortality	4.70	3.97	4.34	<.001
Mechanical ventilation	2.62	2.88	2.96	.002
Acute kidney injury	18.75	23.74	21.13	<.001
Circulatory shock	6.99	5.58	7.46	<.001
Upper gastrointestinal bleeding	1.74	1.96	1.89	.0012
Percutaneous coronary intervention	58.41	49.24	53.71	<.001
Coronary artery bypass graft	8.8	6.07	9.48	<.001
Total charge, $	91,092.01	86,835.46	120,174.40	<.001
Length of stay, d	4.32	4.71	4.74	<.001

Values are presented as %, unless otherwise specified.

Table 3. Black race as a predictor of inpatient outcomes.

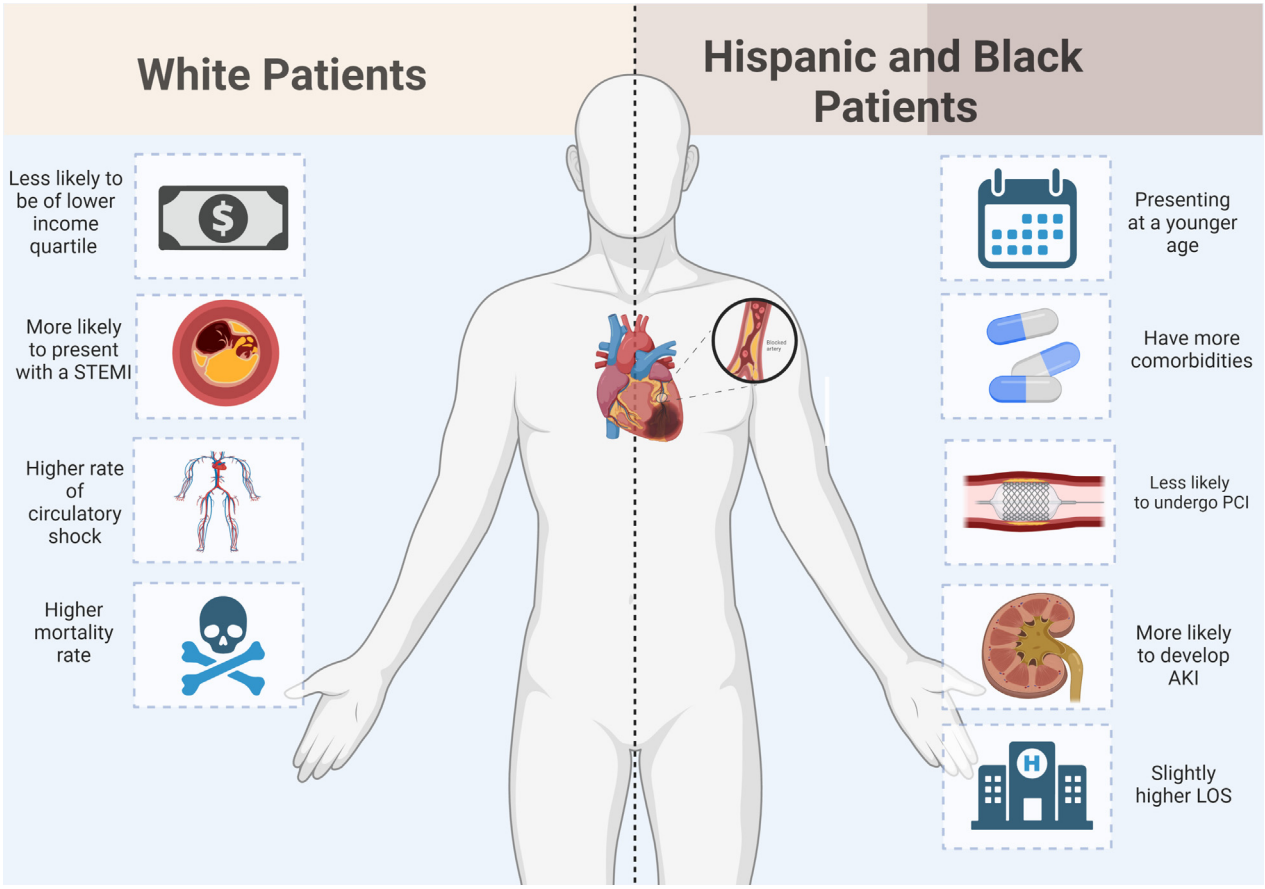
Characteristic		Odds ratio (or coefficient)	Standard error	*P* value	95% CI
Mortality	Unadjusted	0.85	0.02	<.001	0.81-0.89
	Adjusted	0.86	0.02	<.001	0.82-0.90
Mechanical ventilation	Unadjusted	1.08	0.04	.03	1.01-1.17
	Adjusted	0.99	0.03	.077	0.93-1.06
Circulatory shock	Unadjusted	0.78	0.02	<.001	0.74-0.82
	Adjusted	0.78	0.02	<.001	0.75-0.82
Acute kidney injury	Unadjusted	1.33	0.02	<.001	1.29-1.36
	Adjusted	1.12	0.02	<.001	1.09-1.15
Upper gastrointestinal bleeding	Unadjusted	1.06	0.04	.16	0.98-1.14
	Adjusted	1.03	0.04	.37	0.96-1.11
Total charges[a]	Unadjusted	$ −7314.39	$ −873.05	<.001	$ −9025.72 to $ −5603.06
	Adjusted	$ −9182.06	$ −985.33	<.001	$ −11,113.76 to $ −7250.36
Length of stay[a]	Unadjusted	0.35	0.03	<.001	0.28-0.42
	Adjusted	0.21	0.02	<.001	0.16-0.26

[a] Coefficient.

surgery than White and Hispanic patients. Despite all these differences, Black patients experienced lower in-hospital mortality rates than White and Hispanic patients. These findings are not unique to our study.[16,33]

Hispanic patients are also less likely to undergo cardiac procedures and have longer delays in reperfusion, door-to-drug, and door-to-balloon times compared with White patients.[4,14] Moreover, Black and Hispanic patients disproportionately utilize ambulances and are more likely to present to "safety net hospitals" than White patients.[34] Hispanic patients were less likely to undergo a PCI than White patients in our analysis. Our findings showed that Hispanic patients experienced higher rates of in-hospital mortality than Black patients but oddly had lower mortality rates than White patients. Kim et al[33] showed that Hispanic patients, dissimilar to our findings, experienced higher mortality rates than their White counterparts. These differences may be explained as they looked at national outcomes from 2008 to 2011,[33] whereas we looked at outcomes from 2015 to 2018.

Our White population was significantly older than the Black and Hispanic patients. Older patients have a lower likelihood of reporting chest pain when presenting with ACS and, therefore, are more likely to have delays in seeking care and experience delays in urgent interventions.[35,36] Because of delays in treatment and other reasons related to aging, older patients are at higher risk of experiencing unfavorable outcomes and treatment-related complications.[36] Although age may contribute to higher mortality rates in White patients in our sample, when we adjusted for age and other variables, we found that the Black race independently predicted decreased mortality in patients with ACS



Central Illustration. Racial and ethnic disparities in acute coronary syndrome.

compared with White patients. White patients were also more likely to have CAD, as depicted by higher rates of prior MI and PCI. In 1 study, Black patients presenting with NSTEMIs were more likely than White patients to be clear of CAD during their catheterization.[37] In our sample, Black patients presenting with ACS were the least likely to present with a STEMI; a study showed similar findings, with Black patients being the least likely to present with STEMI despite comorbid conditions.[16] A French registry study demonstrated lower adjusted short-term mortality in patients with NSTEMI than in patients with STEMI (0.58; 95% CI, 0.36-0.94; $P = .03$), a finding not exclusive to their study.[38–41] Because our White cohort was most likely to have STEMI, this could potentially have contributed to higher mortality rates. Moreover, a "paradox" where patients with more comorbidities such as hypertension, diabetes, and tobacco had better outcomes in MI is well described in the literature.[42–45] There could have been multiple other factors that we could not account for that contributed to lower in-hospital mortality rates in Black patients, such as out-of-hospital death and death on arrival.[46]

Black and Hispanic patients were more likely to develop an AKI than White patients. This could be related to both these racial/ethnic groups being more likely to have a history of CKD because that is a well-recognized risk factor for AKI.[47] The fact that Black patients were more likely to have a history of CKD and develop AKI during their admission could possibly relate to lower PCI rates. Additionally, Black and Hispanic patients also experienced higher rates of UGIB and respiratory failure requiring mechanical ventilation than their White counterparts during their admission. However, when we adjusted for other variables, the Black race did not predict UGIB and respiratory failure requiring mechanical ventilation. Hispanic patients were the most likely to develop circulatory shock as an inpatient complication.

Racial and ethnic disparities usually arise from socioeconomic and geopolitical factors rather than physiologic or genetic variations.[48,49] Consequently, when discussing racial and ethnic cardiovascular disease outcome disparities, we must discuss socioeconomic factors, as differences often exist between these groups. As shown in the literature, socioeconomic disparities can significantly influence mortality rates in patients presenting with ACS.[22,50] In a study evaluating ACS outcomes based on insurance type, Medicaid insurance was found to be a predictor of mortality compared with private insurance (adjusted OR, 1.16; 95% CI, 1.03-1.30; $P = .01$).[51] Black and Hispanic patients were more likely to be in the lowest income quartile and have Medicaid insurance than their White counterparts; however, as mentioned above, they experienced less in-hospital mortality. Strangely, despite Hispanic patients being more likely to be of a lower socioeconomic group, they incurred the highest amount of total hospital charges than other racial groups. Additionally, geographic location has also been associated with worse in-hospital acute MI mortality outcomes in patients living in rural areas compared with those living in urban areas.[52] We found that White patients were more likely to present to rural hospitals than Black and Hispanic patients, which could have contributed to the increased mortality rate; however, the Black race independently predicted decreased mortality despite adjusting for hospital location. Hispanic patients have previously been shown to have a longer hospital stay.[14] In our study, Hispanic and Black patients had extended hospital stays than White patients; however, when other variables were adjusted, we only noted a weak positive association between the Black race and length of stay.

Limitations

Our study has limitations. First, our data are limited to index hospitalization; thus, information on postdischarge short-term and long-term outcomes is limited. This can be significant as Black patients were shown to have more adverse symptoms resulting in more clinic visits and readmissions within 1 month after ACS admission.[4,14] Second, comorbidities and complications are identified using the *International Classification of Diseases, Tenth Revision* codes, which are subject to suboptimal or coding errors that can lead to bias. Third, we did evaluate language barriers for our patients, which could potentially affect outcomes. Fourth, information regarding echocardiographic, angiographic, and hemodynamic data are unavailable in this database. Fifth, patients with a diagnosis of NSTEMI can potentially be those secondary to type 2 from a demand mismatch. Moreover, this could potentially affect the results because it could be more likely in Black patients as they have higher rates of CKD and congestive heart failure. Finally, despite our attempts at controlling for confounders using multivariate analysis, it is possible that the observed results could be because of lingering confounding factors.

Conclusion

In this nationally representative study, we highlight that racial and ethnic disparities in ACS outcomes and resource utilization continue to exist. Despite having higher cardiometabolic comorbidity burden, lower socioeconomic status, and lower rates of percutaneous intervention, Black and Hispanic patients experienced lower in-hospital mortality rates than their White counterparts. Hispanic patients incurred the highest amount of total hospital charges for an ACS admission. Further studies must now evaluate how to best address these disparities by identifying the cause of these differences.

Declaration of competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethics statement and patient consent

The research reported has adhered to the relevant ethical guidelines. Institutional review board approval and informed consent were not required for this study because National Inpatient Sample data are de-identified and publicly available.

Supplementary material

To access the supplementary material accompanying this article, visit the online version of the *Journal of the Society for Cardiovascular Angiography & Interventions* at https://doi.org/10.1016/j.jscai.2022.100451.

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