


RESEARCH LETTER

# Rocuronium Versus Succinylcholine in Patients With Acute Myocardial Infarction Requiring Mechanical Ventilation

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**P**atients with acute myocardial infarction (AMI) who require invasive mechanical ventilation (IMV) are a critically ill patient population with a high risk of mortality.<sup>1,2</sup> Endotracheal intubation often requires rapid sequence induction with a neuromuscular blocking agent (NMBA).<sup>3</sup> It remains uncertain which NMBA is superior, with some studies finding improved first-attempt success with succinylcholine,<sup>4</sup> whereas others have found similar outcomes with rocuronium.<sup>5</sup> Prior studies evaluating NMBAs for induction enrolled a low proportion of participants with primary cardiovascular disease.<sup>4,5</sup> We therefore evaluated the association between rocuronium and succinylcholine with in-hospital mortality in a multicenter cohort of patients with AMI requiring IMV.

We used the Vizient Clinical Data Base, which at the time of data extraction included >650 US hospitals. Patients aged  $\geq 18$  years who were admitted between October 2015 and December 2019 with a primary diagnosis of AMI, required IMV, and received only succinylcholine or only rocuronium on the day of intubation were included. We excluded patients who underwent surgery on the day of intubation. Patient characteristics were described stratified by NMBA. Multilevel logistic regression models were constructed to evaluate the association of NMBA with in-hospital

mortality, adjusting for demographics (age and sex), comorbidities (coronary artery disease, heart failure, end-stage renal disease, and chronic pulmonary disease), admission characteristics (cardiogenic shock, out-of-hospital cardiac arrest, percutaneous coronary intervention, vasoactive medication, mechanical circulatory support, noninvasive ventilation, and renal replacement therapy before or on the same day as intubation), and hospital characteristics (number of beds and Association of American Medical Colleges teaching status), and accounting for center effect by including a random intercept for center. We constructed 2 sensitivity analyses, first excluding patients initiated on extracorporeal membrane oxygenation and second using inverse probability of treatment weighting to address residual confounding. We assessed covariate balance using weighted standardized differences with a target difference  $< 0.10$ . Data analyses were performed using STATA 16.0 (Stata Corp, College Station, TX). Requests for data access may be sent to Vizient, Inc, at [cdpinfo@vizientinc.com](mailto:cdpinfo@vizientinc.com). The study included deidentified data and was exempt from institutional review board review.

We identified 5604 patients, of whom 3341 (59.6%) received rocuronium (Table). Compared with those receiving succinylcholine, patients given rocuronium

**Key Words:** acute myocardial infarction ■ mechanical ventilation ■ neuromuscular blocking agent ■ rapid sequence induction ■ respiratory failure

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This article was sent to Julie K. Freed, MD, PhD, Associate Editor, for review by expert referees, editorial decision, and final disposition.

For Sources of Funding and Disclosures, see page 3.

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**Table. Patient Demographics and Clinical Characteristics for Patients With AMI Requiring Mechanical Ventilation**

Patient characteristics	Neuromuscular blocking agent		P value	Weighted standardized differences*
	Rocuronium (N=3341)	Succinylcholine (N=2263)		
Demographics				
Age, y	65.5±12.6	67.1±12.3	<0.001	-0.011
Sex				
Men	2275 (68.1)	1476 (65.3)	0.03	0.008
Women	1066 (31.9)	785 (34.7)		
Race or ethnicity				
White	2143 (64.1)	1508 (66.6)	<0.001	-0.001
Black	568 (17.0)	427 (18.9)		
Hispanic	212 (6.4)	112 (5.0)		
Other†	418 (12.5)	216 (9.5)		
Medical comorbidities				
CAD	2890 (86.5)	1982 (87.6)	0.24	0.001
Heart failure	1889 (56.5)	1082 (47.8)	<0.001	0.001
Valvular heart disease	491 (14.7)	316 (14.0)	0.44	0.002
Stroke	212 (6.4)	101 (4.5)	0.003	-0.003
PVD	491 (14.7)	241 (10.7)	<0.001	0.013
Hypertension	1833 (54.9)	1081 (47.8)	<0.001	0.009
Diabetes	1202 (36.0)	727 (32.1)	0.003	<0.001
Dyslipidemia	1851 (55.4)	1280 (56.6)	0.39	0.008
ESRD	344 (10.3)	141 (6.2)	<0.001	-0.006
Chronic pulmonary disease	740 (22.2)	601 (26.6)	<0.001	-0.002
Cancer	89 (2.7)	58 (2.6)	0.82	-0.001
Liver disease	227 (6.8)	120 (5.3)	0.02	<0.001
Admission characteristics				
Cardiogenic shock	1533 (45.9)	947 (41.9)	0.003	<0.001
Out-of-hospital cardiac arrest	585 (17.5)	387 (17.1)	0.69	0.002
PCI‡	1637 (49.0)	1210 (53.5)	0.001	<0.001
Vasoactive medication‡	2582 (77.3)	1624 (71.8)	<0.001	<0.001
IABP‡	734 (22.0)	510 (22.5)	0.62	-0.009
pLVAD‡	474 (14.2)	287 (12.7)	0.11	-0.001
ECMO‡	328 (9.8)	76 (3.4)	<0.001	0.017
NIV‡	217 (6.5)	160 (7.1)	0.40	-0.008
RRT‡	206 (6.2)	50 (2.2)	<0.001	-0.010
Hospital characteristics				
No. of beds			<0.001	-0.004
<350	367 (11.0)	307 (13.6)		
350–499	435 (13.0)	337 (14.9)		
500–750	1243 (37.2)	928 (41.0)		
>750	1296 (38.8)	691 (30.5)		
AAMC teaching hospital	2753 (82.4)	1651 (73.0)	<0.001	0.001

Values are mean±SD or number (percentage). Data from Vizient Clinical Data Base used with permission of Vizient, Inc. All rights reserved. AAMC indicates Association of American Medical Colleges; AMI, acute myocardial infarction; CAD, coronary artery disease; ECMO, extracorporeal membrane oxygenation; ESRD, end-stage renal disease; IABP, intra-aortic balloon pump; NIV, noninvasive ventilation; PCI, percutaneous coronary intervention; pLVAD, percutaneous left ventricular assist device; PVD, peripheral vascular disease; and RRT, renal replacement therapy.

\*After inverse probability of treatment weighting.

‡Initiated before or same day as intubation.

†Other refers to patients in the Vizient Clinical Database who did not identify as White, Black or Hispanic.

were younger (65.5 versus 67.1 years), and more likely to have heart failure (56.5% versus 47.8%) and end-stage renal disease (10.3% versus 6.2%), but less likely to have chronic pulmonary disease (22.2% versus 26.6%) (all,  $P < 0.001$ ). Patients receiving rocuronium were more likely to present with cardiogenic shock (45.9% versus 41.9%;  $P = 0.003$ ) and undergo extracorporeal membrane oxygenation (9.8% versus 3.4%;  $P < 0.001$ ) before or on the same day as intubation. However, there were no significant differences in the proportion of patients initiated on an intra-aortic balloon pump (22.0% versus 22.5%;  $P = 0.62$ ) or percutaneous left ventricular assist device (14.2% versus 12.7%;  $P = 0.11$ ). There were no significant differences in the proportions of patients who presented with out-of-hospital cardiac arrest (17.5% versus 17.1%;  $P = 0.69$ ). The median proportion of patients who received rocuronium at the hospital level was 59.5% (interquartile range, 40.0%–77.1%), with a >2-fold difference across sites after accounting for differences in presentation characteristics (median odds ratio, 2.72).

Patients who received rocuronium had higher in-hospital mortality compared with those who received succinylcholine (42.4% versus 33.6%;  $P < 0.001$ ). After adjusting for demographics, comorbidities, admission characteristics, and hospital characteristics, rocuronium use remained associated with higher in-hospital mortality (odds ratio [OR], 1.40 [95% CI, 1.23–1.59]). In sensitivity analysis, this association persisted after excluding patients who received extracorporeal membrane oxygenation (OR, 1.46 [95% CI, 1.28–1.66]). After inverse probability of treatment weighting, rocuronium use continued to be associated with a 5.7% (weighted mean; [95% CI, 3.2%–8.2%]) higher in-hospital mortality (Table).

In this large, multicenter study, we found that administration of rocuronium was associated with higher in-hospital mortality compared with succinylcholine in patients with AMI requiring IMV. Succinylcholine may facilitate improved first-attempt success compared with rocuronium,<sup>4</sup> which may be a mechanism by which choice of NMBA affects clinical outcomes. It is also possible that the 2 drugs may have differential effects on the cardiovascular system, which is possibly heightened in ischemic myocardium.

This study has several limitations, including an observational, retrospective design, a lack of clinical variables (eg, vital signs, laboratory data, medication dosage and frequency, and institution of targeted temperature management), and intubation characteristics (eg,  $P_{aO_2}$ , number of attempts, setting, and operator), which could influence outcomes. There are important

differences between groups and likely residual confounding despite multivariable adjustment and inverse probability of treatment weighting analysis. However, this unique database allowed for us to identify diagnoses present on admission, date-stamped procedures, and detailed pharmacy data.

In conclusion, rocuronium use may be associated with higher in-hospital mortality compared with succinylcholine in patients with AMI requiring IMV. Although our results should be interpreted as hypothesis generating only, given the lack of patients with AMI in clinical trials and their unique physiological features, we believe a randomized controlled trial with appropriate rocuronium dosing is necessary to assess outcomes in disease-specific populations, such as AMI, before changing practice.

## ARTICLE INFORMATION

Received February 8, 2023; accepted April 25, 2023.

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### Sources of Funding

None.

### Disclosures

None.

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