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The impact of smoking on third-degree atrioventricular block outcomes: A propensity-matched analysis

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ABSTRACT

Background: Third-degree atrioventricular (AV) blocks are rare but cause significant symptoms and require immediate intervention. Coronary artery disease (CAD) is felt to be the most common etiology. Although smoking is a prominent risk factor for CAD, there is a paucity of data assessing the direct effect of smoking on third-degree AV block.

Methods: We performed a retrospective cohort study on adult-weighted admissions in 2019–2020 with a primary diagnosis of third-degree AV block and a history of smoking using the National Inpatient Sample (NIS) database. In-hospital mortality, rates of pacemaker insertion, cardiogenic shock, cardiac arrest, acute kidney injury (AKI), stroke, tracheal intubation, mechanical ventilation, mechanical circulatory support, vasopressor use, length of stay (LOS), and total hospitalization costs were analyzed using regression analysis. We performed a secondary analysis using propensity score matching to confirm the results.

Results: A total of 77,650 admissions met inclusion criteria (33,625 females [43.3 %], 58,315. Caucasians [75 %], 7030 African American [9 %], 6155 Hispanic [7.9 %]; mean [SD] age 75.4.[10.2] years) before propensity matching. A total of 29,380 (37.8 %) patients with AV block were smokers.A total of 5560 patients with and without a history of smoking were matched for the analysis. Smokers had.decreased odds of mortality (aOR, 0.59; CI, 0.44–0.78; p < 0.001), cardiogenic shock, cardiac arrest, tracheal intubation, mechanical ventilation, shorter LOS, and lower total hospital costs in both the multivariable regression and propensity-matched analyses.

Conclusion: Third-degree AV block had lower in-hospital mortality, cardiogenic shock, cardiac arrest, LOS, and total hospitalization cost in patients with smoking history.

1. Introduction

Atrioventricular (AV) block is a pathological process of the cardiac conduction system that disrupts the impulse transmission from the atria to the ventricle. It is categorized into three types: first-degree AV block, an asymptomatic finding with a fixed prolonged PR interval. Second-degree is divided into two categories, with Mobitz II being more severe and clinically significant. A third-degree or complete heart block is defined as the complete isolation of the atria and ventricles. Type II second-degree and third-degree AV blocks have poor prognosis and require either treatment modification or pacemaker implantation [1]. Recent studies have shown increased utilization of pacemakers, especially in the aging population [2,3].

The prevalence of third-degree AV blocks is unknown because of the lack of large population-based studies [4]. One estimate of Mobitz I and Mobitz II second-degree AV block in healthy individuals was 1–2% and 0.003 %, respectively [5], whereas the prevalence of third-degree AV block in the general adult population was 0.02–0.04 % [6]. Patients with third-degree AV block typically present with fatigue, exertional dyspnea, chest pain, presyncope or syncope, and occasionally sudden cardiac arrest [7]. When left untreated, these patients are at risk for heart failure, cardiogenic shock, and cardiac arrest [8]. While AV blocks can have several etiologies, ischemia after acute coronary syndrome is a common reversible cause [9–11]. Due to this association, coronary artery disease (CAD) has been posited as a potential longitudinal contributor to AV blocks [12]. Other important risk factors include diabetes mellitus and hypertension, with an estimated prevalence of 1.1 % and 0.6 %, respectively [13].

Smoking is known to be associated with cardiac tachyarrhythmias, including supraventricular tachycardia, atrial fibrillation, ventricular

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tachycardia, and fibrillation [14–16]. In contrast, there is weak evidence of an association between nicotine and AV blocks [17]. Smoking has been extensively linked to CAD [18–20]; however, no study has examined the association between smoking and second- or third-degree AV block. We aim to assess the impact of smoking on in-hospital mortality, length of stay, hospital costs, acute kidney injury, cardiogenic shock, cardiac arrest, stroke, tracheal intubation, mechanical ventilation, mechanical circulatory support, vasopressor use, and pacemaker utilization in patients with a primary diagnosis of third-degree AV block.

2. Methods

This is a retrospective cohort study of adult hospitalized patients using the patient cohort from the National Inpatient Sample (NIS) database from January 1, 2019, to December 31, 2020. The NIS is part of the Healthcare Cost and Utilization Project (HCUP), regulated by the Agency for Healthcare Research and Quality (AHRQ) [21]. The NIS 2019 and 2020 sampling frames included data from 49 state organizations, recorded discharge information from 97 % of non-federal short-term US hospitals and covered nearly 98 % of the US population. NIS collects 20 % of the stratified sample of discharge records from all HCUP-participating US community hospitals, excluding long-term acute care facilities and rehabilitation centers. Discharge weights are provided to produce national estimates, approximating 67 million discharges when weights are applied for 2019 and 2020.

2.1. Study patients

Fig. 1 shows the flow diagram of patient selection based on smoking status and propensity-matched analysis. Patients admitted with a primary diagnosis of third-degree atrioventricular block were selected using the International Classification of Diseases (ICD)-10 Clinical Modification codes. Patients with a history or current use of tobacco, nicotine, or cigarettes were identified from the ICD-10 codes. Excluded patients included those who were 1) admitted electively, 2) transferred from a facility, 3) transferred to a larger facility, 4) had missing information, and 5) had a history of pacemaker. The ICD-10 codes are listed in the attached supplemental material.

2.2. Study variables

ICD-10 procedure codes were used to identify weighted admissions of patients who underwent single- or dual-chamber pacemaker insertion (see Supplemental Material). Secondary diagnosis codes were used to identify patients who smoke cigarettes or have nicotine dependence. Separate variables were created for all other comorbid conditions. The NIS provides length of stay (LOS). The total hospitalization cost was generated using Cost-to-Charge Ratio (CCR) files from the HCUP and adjusted for inflation for 2019 and 2020.

2.3. Outcomes

The primary outcome was in-hospital mortality rate. Secondary outcomes were the rates of single- or dual-chamber pacemaker insertion, acute kidney injury, cardiogenic shock, cardiac arrest, stroke, tracheal intubation, mechanical ventilation, mechanical circulatory support, vasopressor use, LOS, and total hospitalization costs.

2.4. Statistical analysis

STATA Statistical Software: Release 18 was used to analyze the results. Continuous variables were reported as weighted means with standard deviation (SD) and categorical data as numbers and percentages. Univariate linear and logistic regression analyses were used to calculate mean and unadjusted odds ratios (ORs) for continuous and categorical variables, respectively. Variables with $p < 0.05$ were included in the multivariable linear and logistic regression analyses to measure weighted means for continuous and adjusted odds ratios for categorical and dichotomous variables. As the control group (Third-degree AV block in non-smokers) was larger than the test group (Third-

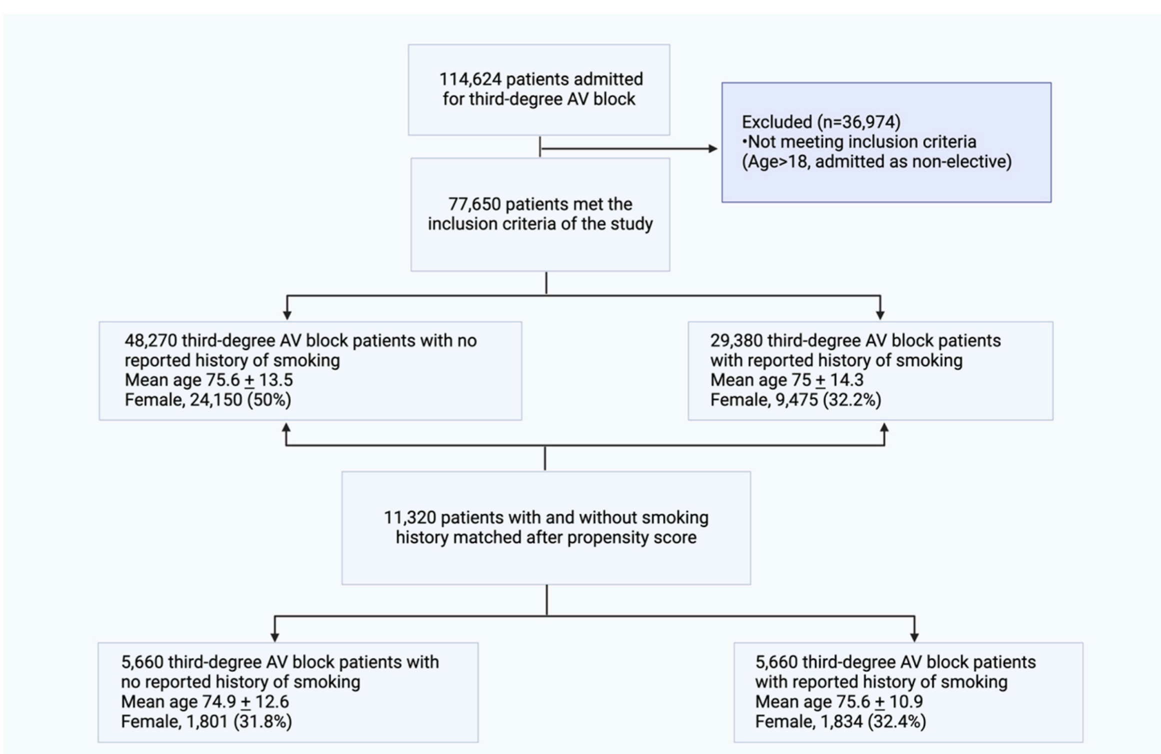

Fig. 1. Flow diagram depicting third-degree AV block patient selection for inclusion based on smoking status and propensity-matched analysis.

degree AV block in smokers), a secondary analysis was performed after propensity score matching (PSM) to confirm the findings. The same variables analyzed in the multivariable analysis were included for propensity matching using a 1:1 nearest neighbor propensity score with a 0.05 caliper width. A secondary multivariable regression model was built on the matched cohort as described above. All p values obtained were two-sided, and statistical significance was set at 0.05.

3. Results

3.1. The pre-match and post-match univariate comparison of patient demographics and co-morbidities

A total of 67 million weighted discharges were included in the NIS 2019 and 2020, of which 77,650 met the inclusion criteria of our study, with a mean age of 75.4 years. Table 1 summarizes the baseline characteristics of the patients before propensity score matching. The pre-match analysis included 33,625 (43.3 %) female patients and the predominant race was Caucasian (74.7 %). There were 29,380 (37.8 %) weighted admissions with a secondary diagnosis of tobacco smoking, including 9475 (32.2 %) female patients. In the pre-match comparison, patients with a history of smoking were more likely to be male (67.8 vs. 50 %, $p < 0.001$), Caucasian (81 vs. 74.7 %, $p < 0.001$), and have a higher Charlson comorbidity index (41.7 vs. 36.3 %, $p < 0.001$). The distributions of the other demographic parameters were similar in both groups. In terms of medical comorbidities, patients with a smoking history had a higher incidence of hyperlipidemia, coronary artery disease, history of myocardial infarction, and percutaneous coronary intervention (PCI). There were no differences in the incidence of hypertension, diabetes mellitus, congestive heart failure, hypothyroidism, or OSA.

Variables from Table 1 were used to generate a propensity score and 5,660 were matched in each cohort of third-degree AV block (smokers and non-smokers). The baseline characteristics of the matched cohorts are presented in Table 2. The demographic and medical comorbidities of both groups were neutralized after propensity matching.

3.2. The pre-match and post-match comparisons of hospital outcomes

Tables 3 and 4 summarize the comparison of hospital outcomes in the pre- and post-matching cohorts. In the pre-match analysis, patients with a smoking history had decreased in-hospital mortality (1.41 vs. 2.66 %, $p < 0.001$; OR, 0.59; CI, 0.44–0.78; $p < 0.001$), shorter hospital stays (3.46 vs. 3.8 $p < 0.001$), and lower adjusted total hospitalization costs (21,508 vs. 22,584). In terms of pre-match hospital complications, smokers had a decreased incidence of cardiogenic shock (3.3 vs. 4.5 %, $p < 0.001$; OR, 0.77; CI, 0.64–0.93; $p < 0.001$), cardiac arrest (4.4 vs. 5.2 %, $p < 0.001$; OR, 0.81; CI, 0.68–0.93; $p < 0.001$), tracheal intubation (3.1 vs 4.6 %, $p < 0.001$; OR, 0.69; CI, 0.57–0.84; $p < 0.001$), and mechanical ventilation (3.8 vs. 5.8 %, $p < 0.001$; OR, 0.65; CI, 0.54–0.78; $p < 0.001$). The rates of AKI, stroke, mechanical circulatory support, and vasopressor use were not significantly different between the two groups.

The results of the propensity-matched analysis closely mirrored those of the multivariate regression analysis. The adjusted and unadjusted in-hospital mortality, cardiogenic shock, cardiac arrest, tracheal intubation, and mechanical ventilation rates remained significant. We found no differences in pacemaker utilization, AKI, stroke, vasopressor use, or mechanical circulatory support use.

On further subgroup analysis based on age, patients between the ages of 45 and 65 years and those above 65 years had higher odds of pacemaker insertion (aOR, 3.44; CI, 2.33–5.07, $p < 0.001$; aOR, 5.38; CI, 3.70–7.83, $p < 0.001$, respectively). The odds ratios for in-hospital mortality, cardiogenic shock, cardiac arrest, mechanical ventilation, and vasopressor use were not different between the groups.

Similarly, on subgroup analysis based on sex, we found that female patients had higher odds of mortality (aOR, 1.49; CI, 1.12–1.98, $p < 0.01$) and lower odds of pacemaker use (aOR, 0.84; CI, 0.74–0.95, $p < 0.01$) compared to males. The other hospital outcomes were similar between the two groups.

Table 1
Patient characteristics before 1:1 propensity matching.

	Non-smoker (n = 48,270)	Smoker (n = 29,380)	p-Value
Age, mean (SD)	75.6 (13.5)	75 (14.3)	<0.001
Women, no. (%)	24,150 (50 %)	9475 (32.2 %)	<0.001
Race/ethnicity, no. (%)			
Caucasian	35,115 (74.7 %)	23,200 (81 %)	
African American	4475 (9.5 %)	2555 (8.9 %)	
Hispanic	4400 (9.3 %)	1755 (6.1 %)	
Asian or Pacific Islander	1430 (3 %)	525 (1.8 %)	<0.001
Native American	230 (0.5 %)	145 (0.5 %)	
Other	1355 (2.9 %)	460 (1.6 %)	
Charlson comorbidity index score, no. (%)			
1	11,080 (23 %)	4685 (16 %)	
2	10,970 (22.7 %)	6525 (22.2 %)	
3	8695 (18 %)	5920 (20 %)	
≥4	17,525 (36.3 %)	12,250 (41.7 %)	<0.001
Median annual income in patients' zip code, no. (%)			
$1–45,999	11,560 (24.3 %)	7365 (25.3 %)	
$46,000–58,999	12,550 (26.4 %)	7450 (25.6 %)	
$59,000–78,999	12,320 (26 %)	7670 (26.4 %)	
> $79,000	11,135 (23.4 %)	6540 (22.5 %)	<0.01
Insurance type, no. (%)			
Medicare	37,440 (79.3 %)	23,025 (80 %)	
Medicaid	1800 (3.8 %)	1100 (3.8 %)	
Private HMO	7275 (15.4 %)	3915 (13.7 %)	<0.01
Self-pay	670 (1.4 %)	475 (1.6 %)	
Hospital characteristics			
Hospital region, no. (%)			
Northeast	9900 (20.5 %)	6025 (20.5 %)	
Midwest	10,285 (21.3 %)	7310 (24.8 %)	
South	18,035 (37.3 %)	10,430 (35.5 %)	
West	10,050 (21 %)	5615 (19.1 %)	<0.001
Hospital bed size, no. (%)			
Small	8830 (18.3 %)	4990 (17 %)	
Medium	14,010 (29 %)	8820 (30 %)	
Large	25,430 (52.7 %)	15,570 (53 %)	<0.01
Urban	45,535 (94)	27,605 (93)	
Rural	2735 (5.6)	1775 (6.2)	0.3
Teaching Hospital	36,690 (76 %)	22,655 (77 %)	<0.01
Comorbidities			
Diabetes mellitus	11,495 (23.8)	7060 (24)	<0.7
Hypertension	19,125 (39.6)	11,775 (40)	0.4
Complicated HTN	21,735 (45)	13,600 (46.2)	<0.01
Hyperlipidemia	25,720 (53.3)	17,630 (60)	<0.001
Obesity	8640 (18)	5470 (18.6)	<0.05
CKD	11,530 (23.9)	7120 (24.2)	0.15
Systolic HF	4095 (8.5)	2715 (9.2)	<0.05
Diastolic HF	13,700 (28.4)	8535 (29)	0.28
Combined HF	1400 (2.9)	1010 (3.4)	<0.01
CAD	15,895 (33)	12,520 (42.6)	<0.001
AMI	6260 (13)	5005 (17)	<0.001
History of MI	3475 (7.2)	3485 (11.8)	<0.001
History of PCI	4390 (9)	4225 (14.4)	<0.001
Hypothyroidism	9420 (19.5)	4920 (16.7)	<0.001
Sepsis	820 (1.7)	260 (0.9)	<0.001
OSA	5340 (11.1)	3915 (13.7)	<0.001

HTN, hypertension; CKD, chronic kidney disease; AMI, acute myocardial infarction; HF, heart failure; CAD, coronary artery disease; MI, myocardial infarction; PCI, percutaneous coronary intervention; OSA, obstructive sleep apnea.

4. Discussion

Our study used the largest population-based database from the NIS to understand the impact of smoking on third-degree AV block. The key findings of our study are as follows: 1) The prevalence of third-degree AV block was higher among men and those with a history of

Table 2
Patient characteristics after 1:1 propensity matching.

	Non-smoker	Smoker	p-Value
n = 11,320	5660	5660	
Age, mean (SD)	74.9 (12.6)	75.6 (10.9)	<0.001
Women, no. (%)	1801 (31.8)	1834 (32.4)	0.5
Race/ethnicity, no. (%)			
Caucasian	4626 (81.7)	4594 (81.1)	
African American	444 (7.8)	502 (8.87)	
Hispanic	398 (7)	340 (6)	
Asian or Pacific Islander	106 (1.9)	105 (1.8)	<0.01
Native American	14 (0.25)	27 (0.48)	
Other	72 (1.27)	92 (1.6)	
Charlson comorbidity index score, no. (%)			
1	1199 (21)	907 (16)	
2	1173 (20.7)	1256 (22)	<0.001
3	966 (17 %)	1132 (20)	
≥4	2322 (41)	2365 (41.7)	
Median annual income in patients' zip code, no. (%)			
$1–45,999	1260 (22)	1419 (25)	
$46,000–58,999	1515 (26.7)	1442 (25.5)	
$59,000–78,999	1522 (26.9)	1505 (26.5)	<0.001
>78,999	1363 (24)	1294 (22.8)	
Insurance type, no. (%)			
Medicare	4404 (79.8)	4439 (81)	
Medicaid	218 (3.95)	204 (3.71)	<0.001
Private HMO	838 (15)	761 (13.8)	
Self-pay	56 (1.02)	91 (1.66)	
Hospital region, no. (%)			
Northeast	1238 (21.8)	1179 (20.8)	
Midwest	1229 (21.7)	1392 (24.6)	<0.001
South	2091 (37)	2014 (35.5)	
West	1102 (19.5)	1075 (19)	
Hospital bed size, no. (%)			
Small	989 (17.4)	949 (16.7)	
Medium	1662 (29.3)	1709 (30.2)	0.47
Large	3009 (53.1)	3002 (53)	
Urban	5328 (94)	5322 (94)	0.81
Rural	332 (5.8)	338 (6)	
Teaching hospital	4308 (76)	4375 (77.3)	0.13
Medical Comorbidities, no. (%)			
Diabetes mellitus	1284 (22.6)	1361 (24)	0.08
Hypertension	2357 (41.6)	2274 (40)	0.11
Complicated HTN	2541 (44.8)	2614 (46.2)	0.16
CAD	2345 (41.4)	2413 (42.6)	0.19
AMI	929 (16.4)	965 (17)	0.36
History of MI	599 (10.5)	673 (11.9)	0.03
History of PCI	710 (12.5)	816 (14.4)	<0.01
Hyperlipidemia	3361(59.3)	3407 (60.1)	0.3
Systolic heart failure	509 (9)	526 (9.3)	0.57
Diastolic heart failure	1553 (27.4)	1643 (29)	0.06
Combined heart failure	219 (3.9)	193 (3.4)	0.19
Chronic Kidney disease	1472 (26)	1375 (24.3)	0.03
Obesity	1085 (19)	1058 (18.7)	0.5
OSA	776 (13.7)	763 (13.4)	0.7
Hypothyroidism	904 (16)	946 (16.7)	0.28
Sepsis	94 (1.6)	51 (0.9)	<0.001

HTN, hypertension, CKD, chronic kidney disease, AMI, acute myocardial infarction; HF, heart failure; CAD, coronary artery disease; MI, myocardial infarction; PCI, percutaneous coronary intervention; OSA, obstructive sleep apnea.

hyperlipidemia, coronary artery disease, and previous myocardial infarction. 2) The in-hospital mortality for third-degree AV block was considerably lower in patients with a history of smoking. 3) Smokers had decreased odds of cardiogenic shock and cardiac arrest. To the best of our knowledge, this is the largest observational study with one-to-one propensity matching to assess the impact of tobacco smoking on third-degree AV blocks.

The increased prevalence of third-degree AV block in men can be explained by a higher burden of AV block and other cardiovascular risk factors in men. Shan et al. performed a population-based study on a national database and reported that older age, male sex, higher BMI, hypertension, and diabetes increased the odds of third-degree AV block [22]. The increased prevalence of hyperlipidemia and coronary artery disease in third-degree AV blocks is also understandable given that they are the core risk factors for atherosclerosis and can induce atherosclerotic insult to the cardiac conduction system. The other important risk factors associated with third-degree AV blocks are idiopathic fibrosis, structural heart damage from congenital, ischemic, and infiltrative cardiomyopathies, and traditional cardiovascular risk factors, including hypertension, hyperlipidemia, diabetes mellitus, and congestive heart failure. Kerola et al. performed a population-based study and reported every 10-mmHg increase in systolic blood pressure and every 20-mg/dl increase in fasting blood glucose was associated with a 22 % higher risk for AV block. Other risk factors associated with AV block include a history of myocardial infarction and congestive heart failure [23]. Less common causes include medications and certain infections such as rheumatic fever, Lyme disease, and infective endocarditis [4]. Cigarette smoking is a well-defined risk factor for several cardiovascular diseases, including hypertension, coronary artery disease, and sudden cardiac death by provoking ventricular arrhythmias [24]. The same cardiovascular risk factors are reported to be associated with AV nodal dysfunction, suggesting a possible link between smoking and third-degree AV block. However, our study findings indicate a contrary conclusion, with decreased odds of in-hospital mortality in patients with third-degree AV blocks. A similar contradictory association has been reported between smoking, coronary artery disease, and stroke [25–27]. However, more recent studies have shown no clear evidence of the "smoker's paradox" [28–30]. These studies linked favorable outcomes in smokers to younger age and higher incidences of thrombotic events; therefore, revascularization therapies had favorable outcomes. The mean age in our study was 75 years in both groups, eliminating age as a possible confounder of the difference in mortality.

Third-degree AV block infrequently complicates ST-elevation myocardial infarction (STEMI), notably inferior wall myocardial infarction due to blockage of the right coronary artery. Studies have shown worse outcomes in patients with STEMI and new third-degree AV blocks [10]. Our study was adjusted for patients who presented with acute myocardial infarction and showed a trend of favorable outcomes in smokers. The distribution of other known risk factors, notably diabetes mellitus, hypertension, congestive heart failure, and hypothyroidism, was similar in both the groups. The smoking cohort was more likely to be male, which is an independent risk factor for AV block. Despite similar distribution and propensity matching, we found higher mortality in the non-smoking group.

Patients with Mobitz type II and third-degree AV block are recommended to undergo pacemaker insertion, regardless of the underlying etiology or symptoms [1]. As expected, we found no statistically significant differences in pacemaker utilization between the two groups. Cardiogenic shock and cardiac arrest are rare, but serious complications of third-degree AV block. Data regarding the incidence and prognosis of cardiogenic shock and cardiac arrest in third-degree AV block are limited to patients presenting with STEMI. Our study found decreased odds of cardiogenic shock and cardiac arrest in patients with third-degree AV block and a secondary diagnosis of smoking, and the results remained significant even after adjusting for confounders in the multivariate analysis.

5. Limitations

Our study has several limitations. The ICD-10 coding methodology within the NIS has inherent limitations. Similar to all previous retrospective studies assessing the role of smoking as a risk factor, the secondary diagnosis codes of smoking are less reliable, as they do not fully capture the total smoking burden in terms of current vs. active smokers, number of pack-years, or type of tobacco consumption. Additionally, smoking may be under-documented in NIS coding, as it is a less emphasized portion of history-taking. Furthermore, the NIS data did not identify individual patients; recurrent hospitalizations were identified as

Table 3
Uni-and multivariable analysis of In-hospital outcomes before and after propensity match for patients with third-degree AV block and a history of smoking.

	Before propensity matching				After propensity matching			
	Univariate, OR (95 % CI)	p-Value	Multivariate, OR (95 % CI)	p-Value	Univariate, OR (95 % CI)	p-Value	Multivariate, OR (95 % CI)	p-Value
In-hospital mortality	0.52 (0.40–0.67)	<0.001	0.59 (0.44–0.78)	<0.001	0.51 (0.39–0.68)	<0.001	0.53 (0.40–0.71)	<0.001
Pacemaker	1.10 (1.00–1.22)	0.05	1.08 (0.97–1.20)	0.15	1.09 (0.97–1.22)	0.12	1.09 (0.96–1.23)	0.13
Cardiogenic shock	0.74 (0.62–0.88)	<0.001	0.77 (0.64–0.93)	<0.01	0.78 (0.64–0.94)	0.01	0.78 (0.64–0.96)	0.02
AKI	0.99 (0.92–1.06)	0.83	0.96 (0.89–1.05)	0.45	0.99 (0.91–1.07)	0.83	1.01 (0.92–1.10)	0.76
Intubation	0.68 (0.57–0.81)	<0.001	0.69 (0.57–0.84)	<0.001	0.82 (0.67–0.97)	0.04	0.82 (0.66–0.96)	0.04
Mechanical ventilation	0.65 (0.55–0.76)	<0.001	0.65 (0.54–0.78)	<0.001	0.76 (0.64–0.92)	<0.01	0.75 (0.62–0.91)	<0.01
Vasopressor use	0.80 (0.63–1.01)	0.06	0.83 (0.64–1.08)	0.17	0.89 (0.66–1.18)	0.42	0.91 (0.68–1.21)	0.51
MCS	0.79 (0.43–1.45)	0.45	0.73 (0.38–1.39)	0.3	0.68 (0.33–1.38)	0.29	0.73 (0.34–1.6)	0.43
Stroke	1.02 (0.69–1.50)	0.9	0.91 (0.58–1.41)	0.67	0.67 (0.43–1.03)	0.06	0.71 (0.45–1.10)	0.12

AKI, acute kidney injury; MCS, mechanical circulatory support.

Table 4
Comparison of In-hospital outcomes before and after propensity match for patients with third-degree AV block and history of smoking.

	Before propensity matching			After propensity matching		
	Non-smoker	Smoker	p-Value	Non-smoker	Smoker	p-Value
In-hospital mortality (%)	2.66	1.41	<0.001	2.61	1.36	<0.001
Pacemaker (%)	87.5	88.6	0.05	87.92	88.5	0.26
Cardiogenic shock (%)	4.5	3.3	<0.001	4.89	3.32	<0.001
Cardiac arrest (%)	5.2	4.4	0.02	5.67	4.24	<0.001
AKI (%)	26.8	26.7	0.83	26.7	26.5	0.8
Intubation (%)	4.6	3.1	<0.001	4.73	3.09	<0.001
Mechanical ventilation (%)	5.8	3.8	<0.001	6.18	3.76	<0.001
Vasopressor use (%)	1.9	1.55	0.06	1.77	1.57	0.42
MCS (%)	0.32	0.26	0.45	0.42	0.23	0.07
Stroke (%)	0.6	0.65	0.9	0.64	0.62	0.9
Median LOS (IQR)	3 (2–5)	2 (2–4)	<0.001	3(2–6)	2(2–5)	<0.001
Hospital Costs ($)	23,107	21,956	<0.001	23,092	21,354	<0.001

AKI, acute kidney injury; MCS, mechanical circulatory support; LOS. Length of stay.

distinct records. We addressed this problem by removing patients with a history of pacemakers. Finally, NIS data only contains inpatient-level data; thus, patients with presentations or pacemaker implementations in the outpatient setting are not part of the sample.

6. Conclusion

In summary, using our population-based database, we found that smoking was associated with lower in-hospital mortality. Our study concurred with previous research and showed a higher prevalence of third-degree AV blocks among men and patients with a history of coronary artery disease, hyperlipidemia, and a history of myocardial infarction. We found that smokers had decreased odds of cardiogenic shock, cardiac arrest, tracheal intubation, mechanical ventilation, and lower healthcare utilization. While our study suggests a smoker's paradox in third-degree AV block, we recommend more research to conclusively establish this association.

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CRediT authorship contribution statement

Mirza Faris Ali Baig: Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation. **Kalyan Chaliki:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijcrp.2024.200289.

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