

# Bradycardia in Older Patients in a Single-Center Emergency Department: Incidence, Characteristics and Outcomes

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**Objective:** This study aimed to explore data associated with the characteristics, incidence, and outcomes of older patients with symptomatic bradycardia presenting to the emergency department (ED).

**Methods:** We prospectively reviewed data of all patients aged 60 years and older who visited our ED with symptomatic bradycardia during 8AM-12PM between June 4, 2018, and June 10, 2019. The outcomes were the incidence of symptomatic bradycardia and adverse events (recurrent bradycardia, rate of ED revisits, subsequent hospitalization, mortality rate, and composite outcomes) at 30 days and 180 days.

**Results:** A total of 3297 patients visited the ED. Of these, 205 patients had symptomatic bradycardia. The incidence of symptomatic bradycardia was 6.2% (205/3297). One hundred fourteen patients (55.7%) were female, and the mean age was 74.9 (SD, 9) years. One-third of bradycardia patients (80 patients [39.0%]) were admitted to the hospital, 32 of whom because of unstable bradycardia. Ten of these 32 (30%) patients died during hospitalization from causes unrelated to bradycardia. One-third of unstable bradycardia patients had dyspnea (10/32 patients [31.3%]) followed by chest pain and altered mental status, respectively. ED revisit was the most common adverse event after 30 days (10.8%) and 180 days (20.3%). End-stage renal disease with hemodialysis was associated with adverse outcomes at 30 days (odds ratio, 2.34; 95% confidence interval, 1.30–20.87).

**Conclusion:** The incidence of symptomatic bradycardia among older adults was 6.2% in one urban ED. End-stage renal disease with hemodialysis was associated with adverse outcomes at 30 days. Larger studies should confirm this association and investigate methods of minimizing adverse outcomes.

**Keywords:** emergency medicine, bradycardia, older adults, adverse event

## Introduction

Bradycardia is one of several peri-arrest complications<sup>1</sup> and when occurs secondary to pathological effects, it can result in decreased cardiac output, hypotension and hypoperfusion.<sup>2</sup> Two major causes of bradycardia include (1) abnormal conduction of the electrical signal in the heart, such as abnormal sinus node and atrioventricular (AV) node, and (2) other factors such as myocardial infarction, abnormal metabolism, infection, pulmonary embolism, toxins, or drugs (ie, beta-adrenergic blockers, calcium channel blockers, digoxin, alpha-adrenergic agonists, and cholinergic agents).<sup>3,4</sup> A study of patients who presented to emergency department with symptomatic bradycardia excluded sinus bradycardia in the US showed a rate of heart block of 38.6% and bradycardia-related with reversible causes of 11.9%.<sup>5</sup>

Older adults frequently visit the emergency department (ED) with complaints of bradycardia. A study of compromising bradycardia in the ED found that one-third of these patients present with syncope and 48% show high grade AV block, sinus bradycardia/AV block 17% and sinus arrest 15% on ECG.<sup>6</sup> One retrospective study in an ED found that patients with

AV block presented more frequently (57.7%) with hypotension than those with other bradycardias (38.3%).<sup>7</sup> A study in a Singapore ED found that chest pain with bradycardia accounted for 29.6% of major adverse cardiac events at 30 days.<sup>8</sup> Still, there remains a paucity of information about the prevalence of bradycardia in the ED as well as the long-term outcomes after ED treatment. The purpose of this study was to determine the incidence of bradycardia, clinical data, and treatment in the ED setting by analyzing the adverse outcomes at 30 days and 180 days after ED disposition.

## Methods

### Study Design

This was a prospective study at one urban academic hospital in Bangkok, Thailand. This study was designed to determine the incidence, patient characteristics, and outcomes of patients with symptomatic bradycardia. Patients aged 60 years and older who visited the ED during 8:00 AM to 12:00 PM (morning and afternoon shifts) between June 4, 2018, and June 10, 2019, were included. The information was collected from patients or relatives if patients were not able to provide information by themselves. The patients who were transferred into or out of the hospital and those who had cardiac arrest were excluded. The primary outcome was the incidence of symptomatic bradycardia. Secondary outcomes were adverse events at 30 days and 180 days after discharge from the ED. This study was approved by the hospital's institutional review board.

### Data Collection Process

Data were collected by emergency medicine residents currently in the training program (PGY 1–3) who were on duty from 8:00 AM to 12:00 PM, seven days a week. The principle investigator gave a one-hour lecture on the data collection process and clarified the terminology of the variables. If there were any questions about the data collection process, the emergency medicine residents were able to contact the PI directly. To verify the quality of data collection, the PI checked the patients' medical records every two days.

### Data Collection

Patient characteristics collected included patient age, gender, initial symptoms (chest pain, dyspnea, palpitation, syncope, acute altered mental status), initial blood pressure, comorbidities (coronary artery disease, hypertension, hyperlipidemia, diabetes mellitus, heart failure, left ventricular systolic dysfunction, pericarditis/myocarditis, congenital heart disease, significant valvular heart disease, recent cardiac surgery, history of valve surgery/percutaneous valvuloplasty, cerebrovascular disease, chronic obstructive pulmonary disease, end-stage renal disease (ESRD) with dialysis, thyroid disease), cardiac rhythm, current medications, ED disposition places, admission rate, and adverse events at 30 and 180 days. Confirmation of electrocardiography (ECG) analysis was performed by a cardiologist who was blind to the interpretation of the ED ECG.

### Definitions

Bradycardia was defined as a heart rate <60 beats/min (bpm) in adults.<sup>1</sup> Symptomatic bradycardia was considered to be a heart rate less than 60 bpm that elicited signs and symptoms.<sup>1</sup> Unstable bradycardia was defined as bradycardia resulting in hypotension, acutely altered mental status, ischemic chest discomfort, and acute heart failure.<sup>1</sup>

Acute altered mental status was defined as confusion, acting abnormally, altered behavior, generalized weakness, lethargy, agitation, psychosis, disorientation, inappropriate behavior, inattention, and hallucination.<sup>9</sup>

Left ventricular systolic dysfunction was defined as a left ventricular ejection fraction less than 40%.<sup>10</sup> Significant valvular heart disease was defined as severe valve regurgitation or stenosis requiring intervention. Cardiac surgery was defined as a specialty of medicine concerning the surgical treatment of pathologies related to the heart and thoracic aorta. In this research, cardiac rhythms were classified according based on patient characteristics, including sinoatrial exit block type I, sinoatrial exit block type II, sinus arrest/sinus pause, second degree AV block, Mobitz II, second degree AV block; 2:1, second degree AV block; 3:1/4:1 (high grade), third-degree AV block, sinus bradycardia, slow atrial fibrillation. If the ECG was not indicative of any particular type of cardiac rhythm, the rhythm was identified as unspecified.

Current medications used by patients included diuretics, calcium channel blockers, beta-blockers, angiotensin II receptor blocker, angiotensin-converting enzyme inhibitors, digoxin, and amiodarone.

Patient outcomes were followed up at 30 and 180 days after hospital discharge. Outcomes were defined as 30-day and 180-day mortality rate, recurrent bradycardia, ED readmissions, subsequent hospitalization, and composite outcomes. We assessed the outcomes of all enrolled subjects at 30 days and 180 days after their discharge from the ED by reviewing the medical records of all admitted patients and conducting telephone interviews of all discharged patients. We checked the death status of all follow-up patients from the hospital medical record and the Thai National Health Security Database.

## Statistical Analysis

Data were analyzed using STATA software version 15.0. Continuous data were presented as means and standard deviation (SD). Categorical data were analyzed using the Pearson's chi-square or Fisher's exact test, where appropriate. A *P* value <0.05 was considered statistically significant.

We chose variables with *P* values less than 0.2 for the regression model and used the enter methods. The model fitting was tested by using the Hosmer-Lemeshow goodness-of-fit, and the *P* value was 0.93.

## Results

A total of 3297 patients (aged 60 years and older) visited the ED during the study period. Of these, 210 patients had bradycardia, 4 patients were referred out of the hospital, and 1 patient who did not have an ECG available was excluded. Finally, 205 patients participated in the study ([Figure S1](#)). The incidence of symptomatic bradycardia was 6.2% (205/3297 patients).

Among the patients, 114 (55.70%) were female, and the mean age was 74.9 (SD, 9) years. Hypertension (165 patients [80.5%]) was the most common comorbidity found in symptomatic bradycardia patients, followed by dyslipidemia (100 patients [48.8%]), cardiovascular disease (76 patients [37.0%]), and diabetes (76 patients [37.0%]; [Table 1](#)).

Bradycardia was divided into two categories: stable bradycardia and unstable bradycardia. Thirty-two (15.61%) patients had unstable bradycardia. Of those with unstable bradycardia, dyspnea (10 patients [31.26%]) was the most common symptom, followed by chest pain, and altered mental status, respectively. Among patients with unstable bradycardia, ECG revealed sinus bradycardia in 13 patients (39.40%), third-degree AV block in 9 patients (27.20%), junctional rhythm in 6 patients (18.20%), and atrial fibrillation with slow ventricular response in 4 patients (12.50%; [Table 2](#)).

Among the patients in the unstable bradycardia group, 20 patients received one dose of atropine and clinically stable, two patients received two doses of atropine and clinically stable and, 5 received atropine and dopamine, 1 received only dopamine, external pacing was performed in 1 patient after receiving atropine treatment, and 3 patients received only

**Table 1** Baseline Characteristics of Patients with Symptomatic Bradycardia

Patient Characteristic	N = 205 (%)
Female	114 (55.70)
Age, mean (±SD)	74.9 (±9)
Underlying disease	
Hypertension	165 (80.51)
Dyslipidemia	100 (48.82)
Cardiovascular disease	76 (37.11)
Diabetes mellitus	76 (37.00)
Cerebrovascular disease	26 (12.74)
Congestive heart failure	16 (7.81)
Thyroid disease	15 (7.31)
End-stage renal disease with dialysis	9 (4.41)
Valvular heart disease	7 (3.51)
Systolic dysfunction (left ventricular ejection fraction <40%)	6 (2.93)
Chronic obstructive pulmonary disease	4 (2.00)
Pericarditis	1 (0.51)
Smoking	10 (4.94)
Alcohol drinking	7 (3.41%)

**Table 2** Symptoms of Unstable Bradycardia and ECG Before Treatment

Unstable Bradycardia, n=32 (%)	
Symptoms	
Dyspnea	10 (31.26)
Chest pain	6 (18.75)
Altered mental status	6 (18.75)
Syncope	4 (12.50)
Hypotension	3 (9.38)
Palpitation	3 (9.38)
Electrocardiogram	
Sinus bradycardia	13 (39.40)
Third-degree atrioventricular block	9 (27.20)
Junctional rhythm	6 (18.20)
Atrial fibrillation slow rate	4 (12.50)

external pacing in the ED. Among four patients who received external pacing, three patients received permanent pacing and one patients had diagnosis with febrile neutropenia and do not received any life sustaining procedure. [Table 3](#) shows there was no difference in the medications used between the unstable and stable bradycardia group.

One-third of bradycardia patients (80 patients [39.0%]) were admitted to the hospital, 32 of whom had unstable bradycardia. Of those 32 unstable patients, the possible causes of unstable bradycardia were STEMI 8 patients, bradycardia due to B-blocker or non-dihydropyridine calcium channel blocker 6 patients, hyperkalemia 4 patients, aortic dissection 2 patients, complete heart block 4 patients, sick sinus syndrome 1 patients, hypoxia 4 patients, hypothyroid 1 patients, ischemic stroke 1 patients and vasovagal syncope 1 patients. Ten of these 32 (30%) patients died during hospitalization (the cause of death was due to ST elevate myocardial infarction in 1 cases and aortic dissection 1 case, severe infection with multiorgan failure in 4 cases, hypoxia in 2 cases, ESRD without hemodialysis in 1 case, and metastatic tumor in 1 case). There was no recurrent bradycardia after ED disposition. ED revisit was the most common adverse event after 30 days and 180 days of ED disposition (26 patients [12.68%] at 30 days and 32 patients [15.6%] at 180 days; [Table 4](#)).

ESRD with dialysis was associated with 30-day adverse outcomes ([Table 5](#)). When we performed multiple logistic regression analysis, only ESRD with dialysis was associated with 30-day adverse outcomes (odds ratio, 2.34; 95% confidence interval, 1.30–20.88). No factors were associated with adverse outcomes at 180 days ([Table S2](#)).

## Discussion

### Prevalence of Bradycardia

Our study showed that the incidence of symptomatic bradycardia in older adults was 6.2%, and 16% of those bradycardia patients had unstable bradycardia. One-third of unstable bradycardia patients in our study presented with dyspnea.

**Table 3** Medications Used in Symptomatic Bradycardia Patients

Name	Stable, n = 173 (%)	Unstable, n = 32 (%)	P value
Diuretic	47 (27.17)	12 (37.50)	0.24
Angiotensin-converting enzyme inhibitor	13 (7.51)	1 (3.12)	0.37
Angiotensin II receptor blocker	51 (31.21)	11 (34.38)	0.72
Calcium channel blocker	46 (26.59)	9 (28.12)	0.86
Beta-blocker	88 (50.87)	14 (43.75)	0.46
Digoxin	5 (2.89)	0	1.00
Amiodarone	5 (2.89)	0	1.00

**Table 4** Outcomes at 30 and 180 Days After Emergency Department Disposition  
n=205 Patients

Variable	30 Days, n (%)	180 Days, n (%)
Mortality rate	13 (6.34)	16 (7.80)
Emergency department revisited	26 (12.68)	32 (15.61)
Subsequence hospitalizations	5 (2.44)	5 (2.44)
Composite outcomes	39 (19.02)	45 (21.95)

**Table 5** Factors Associated with Adverse Outcomes (Composite Outcomes) at 30 Days

	Total N = 205 (%)	Adverse Events 30 Days N = 39 (%)	P value	Multiple Logistic Regression Odds Ratio (95% CI)	
<b>Gender, female</b>	114 (55.61)	24 (61.54)	0.41		
<b>Medication</b>					
Diuretic	59 (28.78)	10 (25.64)	0.63		
Angiotensin-converting enzyme inhibitor	14 (6.82)	2 (5.13)	1		
Angiotensin II receptor blocker	65 (31.70)	16 (41.03)	0.17	0.59	0.58–2.77
Calcium channel blocker	63 (30.73)	11 (28.21)	0.83		
Beta-blocker	102 (49.75)	20 (51.28)	0.83		
Amiodarone	5 (2.43)	2 (5.13)	0.24		
Digoxin	5 (2.43)	0	1		
<b>Comorbidity</b>					
Cardiovascular disease	76 (37.07)	18 (46.15)	0.19	0.68	0.61–2.78
Hypertension	165 (80.48)	35 (89.74)	0.12	0.88	0.52–5.51
Dyslipidemia	100 (48.78)	21 (53.85)	0.48		
Diabetes mellitus	76 (37.07)	17 (43.59)	0.35		
Heart failure	16 (7.80)	4 (10.26)	0.51		
Left ventricular ejection fraction <40%	6 (2.92)	2 (5.13)	0.37		
Pericarditis	1 (0.48)	0	1		
Valvular heart disease	7 (3.41)	1 (2.56)	1		
Cerebrovascular disease	26 (12.68)	5 (12.82)	0.98		
Chronic obstructive pulmonary disease	4 (1.95)	0	1		
End-stage renal disease with dialysis	9 (4.39)	5 (12.82)	0.01	2.34	1.31–20.88
Thyroid disease	15 (7.31)	5 (12.82)	0.14	1.11	0.60–6.34
Alcohol	7 (3.41)	1 (2.56)	1		
Smoking	10 (4.87)	3 (7.69)	0.41		

The unstable bradycardia rate in our study was consistent that reported by Chadda et al in a study of older adults in the ED with myocardial infarction; they found a 17% rate of unstable bradycardia in the ED.<sup>11</sup> In contrast, Bektas et al reported that 25% of ED patients had unstable bradycardia.<sup>12</sup>

## Symptoms of Bradycardia

One-third of unstable bradycardia patients in our study presented with dyspnea, whereas the study by Sodeck et al of patients presenting with compromising bradycardia found that syncope (33%) was the most common symptom, followed by dizziness (22%) and collapse (17%), respectively.<sup>6</sup>

A study by Chadda et al reported that chest pain associated with acute myocardial infarction, especially inferior and posterior infarction, was more common in patients with unstable bradycardia.<sup>11</sup> Moreover, prior studies found that acute myocardial infarction (MI) was more likely to be sinus bradycardia.<sup>12</sup> Similar to our study, which showed that sinus

bradycardia was a common rhythm found in unstable patients while Swart et al found that 45 of 131 patients presented with AV block, 25 (55.6%) had a discharged diagnosis of acute myocardial infarction.<sup>13</sup>

In term of medications, beta-blockers were the common drug used in symptomatic bradycardia patients. The rate was less than that reported by Jang et al who found the rate of beta-blocker used to be 89.5% and the use of calcium channel blockers to be 23.7% in symptomatic bradycardia patients.<sup>3</sup> A study by Drutel et al found that patients taking calcium channel blockers were likely to have a slow pulse and bradycardia as revealed by ECG.<sup>14</sup> Hypertension was the most common comorbidity in that study. Initially, we anticipated that hypertensive medications would affect the cardiac rhythm. In contrast, our study could not find a difference in drug effect between stable and unstable bradycardia patients and adverse outcomes at 30 days and 180 days.

## Adverse Outcomes

When we followed up with patients up to 180 days after ED disposition, the mortality rate of admitted patients was 10 in 80 patients (12.5%) from causes unrelated to bradycardia, which was higher than the mortality rate in another study of Mayo clinic during 2010–2015 (8.9%).<sup>5</sup> The rate of ED revisits among our patients was about 12.68% at 30 days. This rate was less than that reported in a study by Friedmann et al of all ED visits of older adults, which found a 16% ED revisit rate at 30 days.<sup>15</sup> This can probably be attributed to the fact that all unstable bradycardia patients were admitted to the hospital in our study; the remaining patients may not have had severe or uncertain conditions. ESRD with dialysis was associated with adverse outcomes at 30 days in our study. ESRD with dialysis has not previously been identified as a risk factor for serious adverse outcomes of bradycardia patients, and therefore, the association has rarely been evaluated. Our finding that ESRD with dialysis was associated with adverse outcomes in bradycardia patients merits further study.

This study had several limitations. This was a single-center study, and the results might not be generalizable. Given that the data collection time was during the morning and afternoon shifts, patients with a different severity of bradycardia symptoms might have come to the ED during the night shift. We did not collect the reason for admission for others patients with stable bradycardia. The information was collected from patients or relatives, and thus, some of the information might not be correct because of the severity of disease and the fact that patients were not able to provide information by themselves.

## Conclusions

In summary, the incidence of symptomatic bradycardia among older adults was 6.2% in one urban ED. Dyspnea was the most common symptom of unstable bradycardia. Larger future studies should confirm this association and investigate methods to minimize unstable bradycardia.

## Abbreviations

ED, the emergency department; AV, atrioventricular; ESRD, end-stage renal disease; ECG, electrocardiography; SD, standard deviation; ICU, intensive care unit.

## Available of Data and Material

The data are available from the corresponding author on reasonable request.

## Ethics Approval and Consent to Participate

This study was approved by the Vajira Institutional Review Board (IRB). We have obtained informed consent from study participants. This study complies with the Declaration of Helsinki.

## Code Availability

Stata version 15 software (StataCorp 2017. Stata Statistical Software: Release 15 College Station, TX: StataCorp **LLC**)

## Consent for Publication

This study does not contains any individual person's data.



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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare that they have no conflicts of interest for this work.

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