

ISSN Print: 2708-2709
ISSN Online: 2708-2717

Journal of Diabetes, Metabolism and Endocrinology
https://jdmeonline.com/

Research Article

# Conduction Abnormalities and In-Hospital Mortality in Acute Coronary Syndrome: A Comparative Analysis of Clinical Outcomes and Infarct Location.

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**Article History**
Received: 15.10.2026
Accepted: 12.11.2026
Published: 18.11.2026

Doi: 10.61336/jdme.07/04/28

**Abstract:** ***Background:*** Conduction abnormalities complicating acute coronary syndrome (ACS) may be associated with increased in-hospital mortality. This study evaluated hospital outcomes in patients with and without conduction abnormalities and examined mortality according to conduction phenotype and infarct location. ***Methods:*** A single-centre observational case-control study was conducted at Gauhati Medical College and Hospital, Guwahati, Assam, India, from June 2017 to December 2018. The study included 1,001 patients with ACS, of whom 300 had conduction abnormalities and 701 had no conduction abnormalities. In-hospital mortality was compared between groups using crude risk ratios (RRs), odds ratios (ORs), 95% confidence intervals (CIs) and Fisher exact tests. Mortality was further assessed according to conduction phenotype and infarct territory. ***Results:*** In-hospital mortality was 25.3% (76/300) among patients with conduction abnormalities and 4.9% (34/701) among controls (RR 5.22, 95% CI 3.57–7.65; OR 6.66, 95% CI 4.32–10.25; p<0.001). Mortality among patients with complete atrioventricular block (CHB) was 45.2% (52/115), compared with 13.0% (24/185) among those with other conduction abnormalities (RR 3.49, 95% CI 2.28–5.33). Among patients with CHB, mortality was 72.0% (18/25) in anterior-wall myocardial infarction and 35.7% (30/84) in inferior-wall myocardial infarction (RR 2.02, 95% CI 1.38–2.94; p=0.0024). ***Conclusion:*** Patients with ACS and conduction abnormalities had substantially higher in-hospital mortality than those without conduction abnormalities. Complete atrioventricular block and intraventricular conduction blocks were associated with high case-fatality proportions, particularly in anterior-wall infarction. These unadjusted results support careful electrocardiographic and hemodynamic monitoring.

**Keywords:** Acute coronary syndrome; in-hospital mortality; complete atrioventricular block; anterior myocardial infarction; inferior myocardial infarction; bundle branch block; prognosis.

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## INTRODUCTION

Conduction disorders are among the electrical complications observed during ACS, but their significance is heterogeneous. Nodal conduction slowing during inferior myocardial infarction may be transient, while advanced atrioventricular block or new intraventricular block may accompany extensive myocardial injury, hemodynamic deterioration and increased short-term mortality. Current guidelines emphasize a coordinated assessment of the ischemic syndrome, electrocardiographic changes, circulatory state and need for urgent reperfusion or rhythm support [1,2].

Earlier observational cohorts consistently linked high-grade atrioventricular block and bundle branch block with adverse outcomes after myocardial infarction [5–7,16]. Contemporary studies in patients managed with primary PCI have continued to report increased unadjusted mortality with advanced atrioventricular block, although the strength of independent association differs after accounting for shock, infarct site and markers of illness severity [8–11,13]. These differences underscore the distinction between a conduction disturbance as an etiological cause of death and as a marker of extensive underlying infarction.

The infarct-territory context is particularly relevant to CHB. Atrioventricular block in inferior infarction often involves nodal ischemia or vagal tone; anterior infarction-related CHB may reflect more extensive septal involvement and have less stable escape rhythms. Registry data have identified different mortality associations according to location, suggesting that patients with the same degree of block do not necessarily have the same prognosis [6,11,13].

The present study aimed to compare in-hospital mortality between ACS patients with and without conduction abnormalities, evaluate differences across conduction phenotypes and determine the relationship between infarct location and mortality in patients with complete atrioventricular block.

## MATERIALS AND METHODS

### Study design and participants

A single-centre observational case-control study was conducted in the Department of Cardiology, Gauhati Medical College and Hospital, Guwahati, Assam, India, from June 2017 to December 2018. A total of 1,001 patients admitted with ACS were included. The study group comprised 300 patients with conduction abnormalities, and the control group comprised 701 patients without conduction abnormalities. Patients with pre-existing conduction abnormalities attributable to degenerative heart disease, previous coronary events, valvular heart disease, cardiomyopathy, congenital heart disease, paced rhythm, pulmonary hypertension or other causes unrelated to ACS were excluded.

### Clinical assessment and outcome definitions

All patients underwent detailed clinical assessment, including cardiovascular history, examination and 12-lead electrocardiography. Routine blood investigations, cardiac biomarkers and two-dimensional echocardiography were performed, and coronary angiography was undertaken when clinically indicated. Left ventricular ejection fraction was evaluated by echocardiography. The primary outcome was death during the index hospital admission. Other recorded dispositions included routine discharge, discharge on request, leaving against medical advice and absconding. The patients were categorized by ACS presentation, including anterior-wall, inferior-wall, lateral-wall and posterior-wall myocardial infarction, NSTEMI and unstable angina.

### Phenotype and infarct-location comparisons

Conduction abnormalities included sinus bradycardia, first-degree and second-degree atrioventricular block, complete atrioventricular block, bifascicular block, right bundle branch block and left bundle branch block. Mortality was assessed in each category. For patients with complete atrioventricular block, outcomes were compared between anterior-wall myocardial infarction, inferior-wall myocardial infarction and NSTEMI. Subgroup comparisons were interpreted cautiously because some categories contained relatively few patients.

### Statistical approach

Categorical data were summarized as numbers and percentages. Mortality risk was calculated separately for patients with and without conduction abnormalities. Crude RRs and ORs with 95% CIs were calculated from the observed group counts, and two-sided Fisher exact tests were used for categorical comparisons. Statistical significance was defined as $p<0.05$. These analyses were unadjusted and did not account for differences in infarct severity, hemodynamic instability or treatment.

## RESULTS

### Hospital outcomes by conduction-abnormality status

Overall, 76 of 300 patients with conduction abnormalities died in hospital (25.3%), compared with 34 of 701 without conduction abnormalities (4.9%). The absolute observed mortality difference was 20.5 percentage points. The crude RR of in-hospital death was 5.22 (95% CI 3.57–7.65) and the crude OR was 6.66 (95% CI 4.32–10.25; Fisher $p<0.001$). Routine discharge was recorded for 216/300 (72.0%) in the conduction-abnormality group and 629/701 (89.7%) in controls. Other discharge categories are shown in Table 1; they were retained separately from death and recovery.

**Table 1. In-hospital disposition in ACS patients with versus without conduction abnormalities**

| Recorded disposition | Abnormality (n=300) | No abnormality (n=701) |
|---|---|---|
| Routine discharge | 216 (72.0%) | 629 (89.7%) |
| In-hospital death | 76 (25.3%) | 34 (4.9%) |
| Discharge on request | 1 (0.3%) | 7 (1.0%) |
| Left against medical advice | 7 (2.3%) | 30 (4.3%) |
| Absconded | 0 (0.0%) | 1 (0.1%) |
| Total | 300 (100%) | 701 (100%) |

Values are expressed as number (percentage). Fisher exact test was used for the comparison of in-hospital mortality between groups ($p<0.001$).

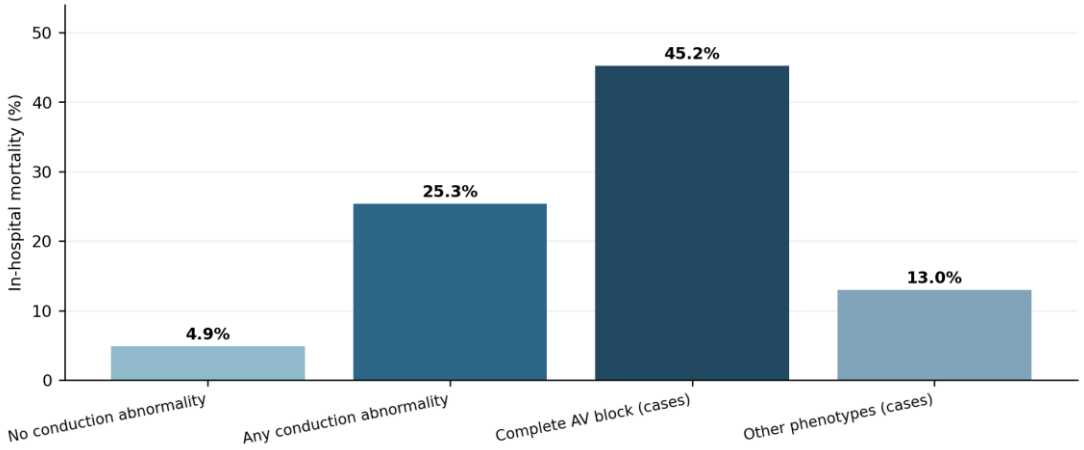


**Figure 1. In-hospital mortality by conduction-abnormality status and by complete AV block within the affected group. Percentages use the denominators shown in Tables 1 and 2.**

**Mortality according to conduction phenotype**

Among the 300 patients with conduction abnormalities, 115 (38.3%) had complete atrioventricular block, with 52 deaths (45.2%). In comparison, 24 of 185 patients (13.0%) with other conduction abnormalities died during hospitalization (RR 3.49, 95% CI 2.28–5.33; p<0.001). Left bundle branch block was associated with 7 deaths among 10 patients (70.0%), and bifascicular block with 8 deaths among 12 patients (66.7%). The observed mortality was 58.3% in right bundle branch block (7/12) and 14.3% in second-degree atrioventricular block (2/14). No deaths occurred among patients categorized with sinus bradycardia or first-degree atrioventricular block (Table 2).

**Table 2. Mortality by recorded conduction phenotype in patients with abnormalities (n=300)**

| Conduction phenotype | Patients, n | In-hospital deaths, n | Case fatality (%) |
|---|---|---|---|
| Sinus bradycardia | 73 | 0 | 0.0 |
| First-degree AV block | 64 | 0 | 0.0 |
| Second-degree AV block | 14 | 2 | 14.3 |
| Complete AV block | 115 | 52 | 45.2 |
| Bifascicular block | 12 | 8 | 66.7 |
| Right bundle branch block | 12 | 7 | 58.3 |
| Left bundle branch block | 10 | 7 | 70.0 |
| Total | 300 | 76 | 25.3 |

AV, atrioventricular. The percentages describe in-hospital mortality within each recorded conduction-abnormality category.

**Complete atrioventricular block by infarct territory**

Complete atrioventricular block was recorded in 115 patients, including 25 with anterior-wall myocardial infarction, 84 with inferior-wall myocardial infarction and 6 with NSTEMI. In-hospital mortality was highest among patients with anterior-wall infarction (18/25, 72.0%), compared with 30/84 patients (35.7%) with inferior-wall infarction and 4/6 (66.7%) with NSTEMI. The risk of in-hospital death was higher in anterior- than inferior-wall myocardial infarction (RR 2.02, 95% CI 1.38–2.94; p=0.0024). The hospital outcomes are shown in Table 3.

**Table 3. In-hospital outcomes among patients with complete AV block, by infarct territory**

| Territory | All CHB, n | Discharged, n | Died, n (%) | Left against advice, n |
|---|---|---|---|---|
| Anterior-wall MI | 25 | 5 | 18 (72.0) | 2 |
| Inferior-wall MI | 84 | 52 | 30 (35.7) | 2 |
| NSTEMI | 6 | 2 | 4 (66.7) | 0 |
| Total | 115 | 59 | 52 (45.2) | 4 |

AV, atrioventricular; MI, myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction. Anterior- versus inferior-wall myocardial infarction: Fisher exact p=0.0024.

**Sex-specific mortality patterns**

Among patients with conduction abnormalities, 23 of 57 women (40.4%) and 53 of 243 men (21.8%) died in hospital. The crude female-to-male RR was 1.85 (95% CI 1.25–2.75; p=0.0063). In controls, mortality was 6.4% among women (7/109) and 4.6% among men (27/592). The sex-specific mortality findings are summarized in Table 4.

**Table 4. In-hospital death by sex and conduction-abnormality status**

| Group | Women: deaths / total (%) | Men: deaths / total (%) |
|---|---|---|
| Conduction-abnormality group | 23/57 (40.4) | 53/243 (21.8) |
| Control group | 7/109 (6.4) | 27/592 (4.6) |

RR, risk ratio. Percentages are calculated within each sex and conduction-abnormality group.

**Revascularization and other outcomes**

Coronary angiography and percutaneous coronary intervention were recorded during the admission. However, in-hospital deaths were not cross-classified by revascularization or pacing status, preventing a reliable comparison of outcomes between medically managed and revascularized patients or between paced and unpaced patients.

## DISCUSSION

Patients with conduction abnormalities had markedly higher in-hospital mortality than those without conduction abnormalities (25.3% vs 4.9%). The crude mortality risk was more than fivefold higher in the affected group. This association is clinically important because conduction disturbances may accompany extensive ischemic injury, left ventricular dysfunction and hemodynamic instability. However, differences in underlying disease severity may contribute to the observed mortality contrast, and causality cannot be inferred from these unadjusted results.

The increased mortality observed in patients with conduction abnormalities is consistent with previous studies. Escosteguy et al. reported increased in-hospital death associated with complete atrioventricular and bundle branch blocks in acute myocardial infarction [5]. Harikrishnan et al. identified adverse hospital outcomes among patients with complete heart block complicating ST-segment elevation myocardial infarction [13]. Auffret et al. similarly demonstrated the clinical severity associated with high-degree atrioventricular block, while highlighting the influence of associated complications and baseline risk [10]. These findings suggest that conduction abnormalities may serve as important markers of high-risk ACS presentations.

Infarct location was associated with substantially different outcomes among patients with complete atrioventricular block. Mortality was 72.0% in anterior-wall myocardial infarction compared with 35.7% in inferior-wall myocardial infarction. Atrioventricular block during inferior infarction may reflect ischemia of the atrioventricular node or increased parasympathetic tone and is often transient. In contrast, complete heart block in anterior infarction may reflect extensive injury to the septum and infranodal conducting system, resulting in a less stable escape rhythm and a greater burden of myocardial necrosis. Comparable differences in prognosis according to infarct location have been described in earlier reports [6,11,13].

Mortality also varied across individual conduction phenotypes. No deaths occurred in patients with sinus bradycardia or first-degree atrioventricular block, whereas complete atrioventricular block, bifascicular block and bundle branch blocks were associated with substantially higher mortality. Although some of these categories contained small numbers, the findings underscore the clinical differences between transient nodal conduction slowing and abnormalities that may accompany extensive structural myocardial injury. Studies in myocardial infarction populations have similarly linked bundle branch block to adverse outcomes [16–18].

Female patients with conduction abnormalities had a higher observed mortality proportion than male patients. This finding may be influenced by age, infarct characteristics, comorbidity and differences in clinical presentation; the present study did not adjust for these potential confounders. Similarly, the available treatment categories do not establish whether revascularization or pacing altered the probability of in-hospital survival. Close clinical monitoring and timely management of hemodynamic compromise remain central to the care of these patients [1,2,9].

The study period predated several contemporary changes in ACS diagnostic and revascularization practice, and absolute mortality proportions may differ in more recent populations. Clinical severity, the onset and duration of conduction disturbances, the presence of cardiogenic shock and the response to treatment are all relevant to interpretation of the observed outcomes. These variables could not be assessed comprehensively in the present comparisons.

**Strengths and limitations**

The main strengths of this study include a large ACS cohort, a comparator group without conduction abnormalities and detailed hospital mortality comparisons across conduction phenotypes and infarct locations. Limitations include its observational single-centre design, absence of risk adjustment for severity of infarction or hemodynamic status, small numbers in selected subgroups and lack of mortality stratification by treatment. Some subgroup disposition counts were not fully consistent with the overall totals; therefore, the mortality comparisons were based on counts that were internally coherent. The findings demonstrate associations but do not establish an independent causal effect of conduction abnormalities on death.

## CONCLUSION

Patients with ACS and conduction abnormalities had substantially higher in-hospital mortality than those without conduction abnormalities. Complete atrioventricular block and intraventricular blocks were associated with high mortality proportions. Among patients with complete atrioventricular block, anterior-wall myocardial infarction carried a greater observed mortality risk than inferior-wall myocardial infarction. Early recognition of conduction abnormalities and careful assessment of infarct location may contribute to clinical risk stratification during ACS admission.

### ETHICAL CONSIDERATIONS

Informed consent was obtained from the patients enrolled in the study.

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