**Prediction of New Onset Atrial Fibrillation in Acute Coronary Syndrome : using C2HEST score**

# Abstract

Atrial fibrillation (AF) is a common complication of acute coronary syndrome (ACS) and is associated with poorer clinical outcomes. This study aims to assess the clinical profile of ACS patients with AF and to evaluate the predictive value of the C₂HEST score. A total of 61 patients with ACS and AF were analyzed for demographics, comorbidities, and risk scores. Most patients had ST-segment elevation myocardial infarction (STEMI) (55.7%), with hypertension and diabetes as prevalent comorbidities. High C₂HEST scores were linked to an increased risk of complications.

# Introduction

Atrial fibrillation (AF) is the most common sustained arrhythmia, often complicating the course of acute coronary syndrome (ACS), a leading cause of mortality worldwide. The presence of AF in ACS patients worsens prognosis by increasing the risk of mortality, heart failure, stroke, and thromboembolic events. New-onset AF in ACS is particularly concerning as it signifies higher morbidity and mortality rates due to the combined risk factors of ischemic heart disease and arrhythmias. This highlights the necessity for early identification and risk stratification to optimize patient management and improve clinical outcomes.

Several scoring systems have been developed to predict the likelihood of AF in patients, one of the most well-known being the C₂HEST score. This score is a simple, clinically useful tool designed to identify patients at high risk of developing AF. The C₂HEST score takes into account factors such as congestive heart failure (C), hypertension (H), age ≥75 years (E), diabetes (D), prior stroke or transient ischemic attack (S), and female sex (T). Higher scores suggest a greater risk of developing AF, which can help guide treatment decisions, including anticoagulation and rhythm control therapies.

Given that the burden of AF in ACS patients is significant, this study aims to evaluate the clinical profile of ACS patients with AF and assess the predictive value of the C₂HEST score in this population. By understanding the relationship between the C₂HEST score and patient outcomes, this study seeks to contribute valuable insights into the management of these high-risk patients.

# Materials and Methods

The C₂HEST score for incident AF was analyzed in 61 subjects hospitalized for acute coronary syndrome complicated by new-onset atrial fibrillation in the cardiology department of Mohamed VI University Hospital, from November 2020 to March 2025. Patients were stratified into risk categories based on the C₂HEST score.

# Results

A total of 61 ACS patients with new-onset AF were included in the analysis.

Table 1 below provides a breakdown of patient demographics and ACS subtypes.

| **Variable** | **Value** |
| --- | --- |
| **Mean Age** | 63.18 years |
| **Female** | 24 (39.3%) |
| **ACS Type** |  |
| - STEMI | 34 (55.7%) |
| - NSTEMI | 17 (27.9%) |
| - STEMI equivalents | 10 (16.4%) |
| **Hypertension** | 29 (47.5%) |
| **Diabetes** | 33 (54.1%) |
| **Dyslipidemia** | 8 (13.1%) |
| **Active Smokers** | 14 (22.9%) |
| **Coronary Artery Disease** | 14 (22.9%) |

Table 2 below illustrates the distribution of C₂HEST risk scores among the study population:

| **Risk Category** | **Number of Patients** | **Percentage (%)** |
| --- | --- | --- |
| Low risk (0-1 points) | 4 | 6.6 |
| Intermediate risk (2-3 points) | 29 | 47.5 |
| High risk (>4 points) | 28 | 45.9 |

**Complications and Associated Conditions:** The high-risk group based on the C₂HEST score showed a significantly higher rate of complications. Notably, heart failure was the most common associated condition in these patients, affecting 38 individuals (62.3%, p < 0.01). Furthermore, 11 patients (18.0%) were diagnosed with significant valvular heart disease, which contributed to their clinical instability during hospitalization.

**Outcomes and Mortality**  
Among the 61 patients, 4 (6.6%) of those in the high-risk category succumbed to their condition, emphasizing the correlation between high C₂HEST scores and adverse outcomes. The average length of hospitalization for all patients was 5.5 days, with the range spanning from 24 hours to 25 days. Patients in the high-risk category tended to have longer hospital stays, reflecting the increased severity of their condition.

# Discussion

The European Society of Cardiology (ESC) defines atrial fibrillation (AF) as the most common sustained cardiac arrhythmia. It is a supraventricular rhythm disorder characterized by uncoordinated atrial electrical activation, which leads to ineffective atrial contraction. On surface electrocardiography (ECG), AF is marked by the absence of distinct P waves and an irregularly irregular ventricular response, with no consistent RR interval pattern in the absence of atrioventricular (AV) block [1].

The incidence of AF in the context of acute coronary syndromes (ACS) is variable, ranging between 2% and 23% [2]. A study conducted at our center demonstrated that 10% of patients admitted for ACS developed new-onset atrial fibrillation [3]. Notably, patients experiencing a myocardial infarction (MI) have a 60–77% increased risk of developing new-onset AF (NOAF) [4]. AF itself is associated with a higher risk of adverse outcomes, including both ST-segment elevation and non-ST-segment elevation MI [5].

Several theories suggest a significant link between AF and ACS :

 **Structural Changes**:

* Myocardial infarction leads to necrosis and remodeling of the heart tissue, particularly affecting the atria. This remodeling includes atrial dilation and fibrosis, which disrupt normal electrical conduction and increase the risk of AF. [6].

 **Inflammation**:

* MI triggers a systemic inflammatory response, releasing cytokines that can lead to electrical remodeling of atrial tissue. This inflammation can contribute to the development of AF by altering ion channel expression and function.(7)

 **Autonomic Nervous System Changes**:

* After an MI, there is often an imbalance in autonomic tone, with increased vagal activity or sympathetic activation. These changes can precipitate AF by affecting the atrial electrical activity.( 8)

 **Electrophysiological Changes**:

* Ischemia during an MI can lead to alterations in atrial repolarization and conduction velocity. These electrophysiological changes can create a substrate for AF, especially in the presence of pre-existing risk factors. (9)

A recent study from the Rotterdam Study provides compelling evidence linking late or unrecognized myocardial infarction (MI) to an increased risk of developing atrial fibrillation (AF). This prospective, population-based cohort study followed 6,175 participants over a mean period of 11.7 years. It found that men with unrecognized MI, identified through electrocardiographic (ECG) signs, had more than double the risk of developing AF compared to men without any history of MI (hazard ratio: 2.21, 95% CI: 1.51–3.23). This association remained significant even after adjusting for age and other cardiovascular risk factors. Interestingly, the same association was not observed in women [10]. This research underscores the importance of early detection and management of myocardial infarctions, including those that are unrecognized, to mitigate the risk of subsequent atrial fibrillation.

Timely risk prediction and appropriate risk stratification are critical in identifying patients at increased risk for AF, especially during acute cardiovascular events. Preventive strategies may reduce the risk of complications such as thromboembolism, heart failure, and increased mortality [11].

One promising tool for AF risk assessment is the C₂HEST score, a simple and validated clinical risk stratification model. The acronym stands for:

* C₂: Coronary artery disease (CAD) and Chronic Obstructive Pulmonary Disease (COPD) – 1 point each
* H: Hypertension – 1 point
* E: Elderly (age ≥ 75 years) – 2 points
* S: Systolic heart failure – 2 points
* T: Thyroid disease (hyperthyroidism) – 1 point [12]

The C₂HEST score has shown predictive value in various clinical scenarios. For instance, it has been used to predict both in-hospital and six-month mortality, as well as non-fatal adverse events such as acute kidney injury, acute heart failure, and cardiogenic shock among elderly COVID-19 patients [13]. Additionally, it has demonstrated utility in predicting NOAF during hospitalization for community-acquired pneumonia (CAP) [14].

A recent study published in the International Journal of Cardiology assessed the predictive value of the C₂HEST and mC₂HEST scores for new-onset atrial fibrillation (NOAF) in patients with acute coronary syndrome (ACS) undergoing percutaneous coronary intervention (PCI). The study utilized data from the multicenter REALE-ACS registry, which included patients from various centers. The findings indicated that both the C₂HEST and mC₂HEST scores demonstrated notable predictive value for NOAF in this clinical setting. Specifically, the C₂HEST score exhibited an area under the curve (AUC) of 0.71, suggesting moderate discriminatory ability. In fact, a C₂HEST score >3 was significantly associated with the development of NOAF in patients presenting with ACS; these results support the utility of the C₂HEST score in identifying ACS patients at higher risk for developing NOAF [15].

Additionally, another study published in BMC Cardiovascular Disorders explored the predictive value of the C₂HEST score combined with the platelet-to-albumin ratio (PAR) for NOAF in elderly patients with acute ST-segment elevation myocardial infarction (STEMI). The study found that both the C₂HEST score and PAR were independent risk factors for NOAF in this patient population. Furthermore, combining these two markers improved prediction accuracy, with a higher area under the curve (AUC) compared to individual indicators [16].

# Conclusion

AF in the context of ACS is associated with significant comorbidities and adverse outcomes. The C₂HEST score effectively stratifies patients by risk and may serve as a useful tool for early identification of individuals at high risk of AF-related complications, enabling targeted management strategies.

# Limitations :

* **Sample Size**: The total number of participants (61) is relatively small, which may limit the generalizability of the findings.
* **Single-Center Study**: Conducting the research at a single center may introduce bias and reduce the applicability of the results to a broader population.
* **Exclusion Criteria**: Patients with pre-existing atrial fibrillation or other significant comorbidities were excluded, which may not reflect the typical clinical population.
* **Time to Consultation**: The average time to consultation was 53.9 hours, indicating potential delays in management that could affect outcomes.
* **Lack of Long-Term Follow-Up**: The study primarily focuses on in-hospital outcomes, which may not capture long-term complications or recurrence of atrial fibrillation.
* **Limited Risk Factors**: While the C₂HEST score includes several important factors, other relevant clinical variables may not have been considered, possibly impacting the predictive accuracy.

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