Demographics and Characteristics of Patients Admitted With Acute Coronary Syndrome to the Coronary Care Unit at King Abdulaziz University

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Abstract

Background

Over the previous decade, the incidence of cardiovascular diseases (CVDs) has risen in the Middle East and will increase mortality to 23 million individuals in Saudi Arabia by 2030, according to the Saudi Ministry of Health. CVDs, including acute coronary syndrome (ACS), are the most common cause of mortality globally. This study aimed to analyze the demographic and clinical characteristics of patients with ACS admitted to the coronary care unit (CCU) in a tertiary hospital in Jeddah, Saudi Arabia. To the best of our knowledge, a lack of research in this region has been undertaken.

Methods

This retrospective records review study was conducted in a tertiary center in Jeddah, Saudi Arabia. All patients admitted to our CCU in 2017 with a final diagnosis of ACS were retrospectively enrolled. Demographic details, coronary risk factors, investigation and procedures, management, and clinical outcomes are all part of the data.

Results

Of the 615 patients included in the study, 491 (79.84%) were males, 226 (36.75%) were 55-64 years old, and 161 (26.18%) were 45-54 years old. Males had a higher rate of ST-segment elevation myocardial infarction (STEMI) (214, 43.58%), while females had a higher rate of non-ST-segment elevation myocardial infarction (NSTEMI) and unstable angina (UA) (45.96% and 37.90%, respectively). Diabetes (62.60%), dyslipidemia (62.44%), and hypertension (61.46%) were the most prevalent risk factors. Angiography and percutaneous coronary intervention (PCI) were performed in 77.72% and 61.95% of patients, respectively. Coronary artery bypass graft was only performed in 4.59% of patients. PCI was performed more frequently in patients with STEMI than in those with NSTEMI/UA (P < 0.001). A large majority of patients (99.5%) recovered and were discharged. Of the 161 (26.18%) patients who attended a follow-up visit, only 45 (33.08%) met the therapeutic objective of 1.8 mmol/L (70 mg/dl) of low-density lipoprotein cholesterol. There were 100 (16.26%) patients readmitted to the CCU, and most of these were readmitted within a year after initial admission. Readmissions were more common in females and patients diagnosed with NSTEMI/UA during initial admission (15.47% and 19.35%, respectively).

Conclusion

This study revealed that our most common demographics were males between 45 and 64 years, which is a decade younger than the global average. STEMI was the most common presentation. The most common modifiable cardiovascular risk factors were hypertension, diabetes, and dyslipidemia. The most common adverse event was reinfarction, which was closely linked to hypertension and diabetes. In this study, the recovery rate was higher than in studies from other countries; however, the majority of patients did not achieve the goal of cholesterol levels at follow-up. Our population’s younger age at presentation necessitates greater attention and more stringent preventive strategies, such as lifestyle changes and evidence-based treatments for CVD risk factors, to reduce the incidence and burden of ACS on CCUs.

Categories: Cardiology, Emergency Medicine, Internal Medicine
Keywords: percutaneous coronary intervention, retrospective studies, non-st elevation myocardial infarction, unstable angina, st-elevation myocardial infarction (stemi), myocardial infarction, saudi arabia, coronary care unit, cardiovascular diseases, acute coronary syndrome

Introduction

Cardiovascular diseases (CVDs) are the leading cause of death worldwide, claiming an estimated 17.9 million lives annually, according to the World Health Organization [1]. CVD refers to a set of disorders that affect the
heart and its blood vessels and can be further categorized into coronary artery disease (CAD) and acute coronary syndrome (ACS) [2]. CAD is defined by atherosclerosis in the coronary arteries, wherein atherosclerotic plaque builds up inside the coronary arteries, restricting blood circulation, and hence, delivery of oxygen to the heart; while CAD can be asymptomatic, ACS is characterized by signs and symptoms of sudden myocardial ischemia caused by CAD [3,4]. ACS is classified as unstable angina (UA), ST-segment elevation myocardial infarction (STEMI), or non-ST-segment elevation myocardial infarction (NSTEMI) [2,5].

The incidence of CVD has increased in the Middle East over the last decade, with numerous studies indicating that CVDs are prevalent in the region [6]. According to the Ministry of Health in Saudi Arabia, CVDs will claim the lives of approximately 25 million people by 2030 [7]. The population of Saudi Arabia and other neighboring Gulf countries mainly carry preventable risk factors due to rapid socio-economic growth, resulting in a massive shift in lifestyle, such as increased intake of low-quality cholesterol-laden meals and adoption of a sedentary lifestyle, which has led to an increase in CVD rates [6,8,9].

The primary reason for coronary care unit (CCU) admission was ACS, as established in a previous single-center study conducted in Saudi Arabia [10]. Since the 1960s, CCUs have been linked to decreased mortality in patients with ACS [11-19]. This is considered associated with more frequent prescriptions of evidence-based medicines and more rigorous monitoring, rapid detection, and treatment of life-threatening arrhythmias [11,17]. However, caring for critically ill patients is unquestionably one of the most challenging and time-consuming elements of intensive care medicine, and the CCU incurs high costs for both health institutions and the medical staff [10,20]. Saudi Arabia has different regions with varying patient demographics, clinical characteristics, management, and quality of care. Exploring these elements may help implement more effective approaches to the prevention and management of ACS and potentially improve healthcare systems, thus minimizing the burden on the CCU. To the best of our knowledge, no studies of this nature have been conducted in Saudi Arabia's western region. Therefore, this study aimed to examine and analyze the demographic and clinical features, management, and outcomes of ACS patients admitted to the CCU at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia.

Materials And Methods

Study setting and participants

This study was a retrospective review of medical records performed in June 2021 at KAUH, a tertiary care center in Jeddah, Saudi Arabia. Between January and December 2017, 673 patients were admitted to our CCU, which includes 10 well-equipped beds for patients with acute cardiac conditions. Of those, we enrolled 615 patients who met the ACS criteria. The diagnosis of ACS was established based on the patient’s clinical presentation (ischemic signs or symptoms compatible with ACS) associated with any of the following: changes in the electrocardiogram (ECG) suggestive of ACS, increase in biochemical markers of cardiac necrosis (creatine phosphokinase, troponin, and creatine kinase-MB), or confirmed CAD. Patients with congenital cardiac abnormalities, incomplete data records, or ACS due to a non-cardiovascular etiology (e.g. trauma or surgery) were excluded.

Evaluated indicators

The hospital records of selected patients were reviewed for baseline demographic characteristics, such as age, sex, nationality, and medical history, including significant coronary risk factors, such as smoking, presence of diabetes mellitus (DM), dyslipidemia, hypertension, obesity, previous ACS event or cerebrovascular accident, congestive heart failure, percutaneous coronary intervention (PCI), or coronary artery bypass graft (CABG). To ensure data consistency, standard definitions were used as follows: (1) smoking status: current smokers (individuals who smoked every day or some days at presentation), non-smokers (people who had never smoked more than 100 cigarettes in their lives), and ex-smokers (individuals who had quit smoking 30 days prior to admission); (2) hypertension: self-reporting of previous hypertension diagnosis or use of anti-hypertensive medications; (3) DM: self-reporting of previous DM diagnosis or use of anti-diabetic medications; (4) dyslipidemia: total cholesterol (TC) > 5.18 mmol/L, low-density lipoprotein cholesterol (LDL-C) > 2.59 mmol/L, or non-high-density lipoprotein cholesterol (non-HDL-C) > 3.37 mmol/L [21]. Obesity is defined as a body mass index (BMI) > 30 kg/m² determined using the Quetelet index formula (mass in kg/height in m²).

Additionally, a comprehensive analysis of lipid profiles and lipid-lowering agents used during admission and follow-up was performed. The therapeutic target value of LDL-C was measured according to the European Society of Cardiology/European Atherosclerosis Society (ESC/EAS) guidelines [22]. Details of hospitalization procedures were recorded, and echocardiographic findings were obtained from final reports confirmed by a cardiologist. The American College of Cardiology’s criteria were used to classify the data on hospitalization procedures were recorded, and echocardiographic findings were obtained from final reports confirming the study. Moreover, in-hospital outcomes, including major adverse cardiovascular events, such as death, resuscitated cardiac arrest, reinfarction, stroke, and major bleeding, were also noted. Finally, readmissions for a new acute coronary event (STEMI, NSTEMI, or UA) during 2017 and 2018, including lipid profiles and medications administered, were recorded and analyzed.
Ethical approval
The study protocol strictly followed standard clinical guidelines and was approved by the Research Ethics Committee (REC) of KAUH (reference number: 299-20). Due to the deidentified nature of the databases, written informed consent was not required; however, each patient’s medical record number was identified and patient confidentiality was preserved.

Statistical analysis
Data were extracted from the hospital’s patient database (Phoenix) and entered into Microsoft Excel 2016 (Microsoft Corporation, Redmond, WA). Quantitative variables are presented as mean ± standard deviation, whereas categorical variables are presented as percentages. The Student's t-test and the chi-square test were used to compare the continuous and dichotomous variables groups, respectively. Statistical significance was set at P < 0.05, and IBM SPSS Statistics for Windows (version 21; IBM Corp., Armonk, NY) was used for all statistical analyses.

Results
Demographic and coronary risk factors profile
In total, 615 patients who had been diagnosed with ACS were enrolled in this retrospective chart review study, and their data were analyzed. Most patients in our study sample were males (79.84%), non-Saudis (76.58%), and between 55 and 64 years old (36.75%) and 45 and 54 years old (26.18%). The most prevalent modifiable cardiac risk factors were DM (62.60%), dyslipidemia (62.44%), and hypertension (61.46%). Subsequently, the patients were separated into three groups as follows: STEMI, NSTEMI, and UA. STEMI was the most common presentation at first admission (38%), followed by NSTEMI (35%). The baseline demographics and coronary risk factors of these patients are shown in Table 1.

| Characteristics | Overall (n = 615) | STEMI (n = 234) | NSTEMI (n = 215) | UA (n = 166) | P-value |
|-----------------|------------------|----------------|-----------------|--------------|---------|
| Gender, n (%)   |                  |                |                 |              |         |
| Males           | 491 (79.84)      | 214 (91.45)    | 158 (73.49)     | 119 (71.69)  | <0.001† |
| Females         | 124 (20.16)      | 20 (8.55)      | 57 (26.51)      | 47 (28.31)   |         |
| Age (years), mean ±SD |              |                |                 |              |         |
| Total           | 57.60 ± 10.99    | 55.91 ± 10.83  | 59.98 ± 11.33   | 56.91 ± 10.30| <0.001† |
| Males           | 59.70 ± 10.59    | 55.79 ± 10.84  | 58.30 ± 10.47   | 56.21 ± 10.12| 0.066†  |
| Females         | 64.16 ± 11.87    | 57.10 ± 10.90  | 64.63 ± 12.37   | 58.68 ± 10.64| 0.009†  |
| Age group, n (%)|                  |                |                 |              |         |
| <45             | 75 (12.20)       | 38 (16.24)     | 16 (7.44)       | 21 (12.65)   |         |
| 45-54           | 161 (26.18)      | 70 (29.91)     | 52 (24.19)      | 39 (23.49)   |         |
| 55-64           | 226 (36.75)      | 73 (31.20)     | 84 (39.07)      | 69 (41.57)   | 0.001*  |
| 65-74           | 111 (18.05)      | 43 (18.38)     | 36 (16.74)      | 32 (19.28)   |         |
| 75-84           | 34 (5.53)        | 8 (3.41)       | 22 (10.23)      | 4 (2.41)     |         |
| ≥85             | 8 (1.30)         | 2 (0.85)       | 5 (2.33)        | 1 (0.60)     |         |
| Nationality, n (%)|                |                |                 |              |         |
| Saudi           | 144 (23.41)      | 45 (19.23)     | 47 (21.86)      | 52 (31.33)   | 0.015*  |
| Non-Saudi       | 471 (76.59)      | 189 (80.77)    | 168 (78.14)     | 114 (68.67)  |         |
| BMI, n (%)      |                  |                |                 |              |         |
| Underweight     | 8 (1.30)         | 2 (0.85)       | 3 (1.40)        | 3 (1.81)     |         |
| Normal          | 220 (35.83)      | 104 (44.44)    | 73 (34.11)      | 43 (25.90)   |         |
| Pre-obesity     | 228 (37.13)      | 89 (38.03)     | 79 (36.92)      | 60 (36.14)   | <0.001* |
Males mostly presented with STEMI (43.68%), compared with females who mostly presented with NSTEMI and UA (45.96% and 37.90%, respectively, P < 0.001). Incidence of obesity was significantly higher among the NSTEMI and UA groups (37.74% and 37.74%, respectively) than among the STEMI group (24.53%, P ≤ 0.001), with a statistically significant sex-specific difference (29.56% of females compared to 70.44% of males, P = 0.001). Remarkably, the occurrence of previous ACS episodes was higher among the NSTEMI and UA groups (P < 0.001), with a noted sex disparity (37.1% of females compared to 24.4% of males, P = 0.017). The incidence of hypertension was noticeably higher in the NSTEMI group (37.83%, P < 0.001), whereas smoking and dyslipidemia were notably more prevalent among patients with STEMI (49.13% and 43.75%, respectively, P = 0.002 and P < 0.001). History of previous heart failure (P = 0.007) or CABG (P = 0.009) was more frequent in the NSTEMI group.

Lipid profile

Analysis of the lipid profile showed that the mean values of TC, LDL-C, triglycerides (TG), and high-density lipoprotein (HDL) were 4.59 ± 1.21, 2.99 ± 1.02, 1.93 ± 1.19, and 1.04 ± 0.35 mmol/L, respectively. Moreover,
the mean lipid profile values were found to differ according to sex in our study. TC (P = 0.039), low-density lipoprotein (LDL) (P = 0.002), and TG (P = 0.001) were remarkably higher in males than in females. However, mean HDL levels were significantly higher in females than in males (P < 0.001) (Table 2).

| Variables            | Males (mean ± SD) | Females (mean ± SD) | P-value |
|----------------------|-------------------|---------------------|---------|
| LDL-C, mmol/L        | 3.05 ± 1.03       | 2.72 ± 0.95         | 0.002*  |
| Total cholesterol, mmol/L | 4.64 ± 1.21     | 4.39 ± 1.18         | 0.039*  |
| Triglyceride, mmol/L | 1.99 ± 1.27       | 1.70 ± 0.77         | 0.001*  |
| HDL-C, mmol/L        | 1.01 ± 0.34       | 1.15 ± 0.35         | <0.001* |

**TABLE 2: Gender differences between lipid parameters at hospital admission**

* Independent t-test.

HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; SD = standard deviation.

Of the 615 patients, 161 (26.18%) returned to the hospital for follow-up visits, and their lipid profile values were analyzed. The mean LDL (P < 0.001), TC (P < 0.001), and TG (P = 0.002) were significantly lower at follow-up than at hospital admission, with a consistent pattern observed for both sexes (Table 3).

| Variables            | Hospital admission (mean ± SD) | Follow-up (mean ± SD) | P-value |
|----------------------|-------------------------------|-----------------------|---------|
| LDL-C, mmol/L        | 2.97 ± 0.94                   | 2.36 ± 1.02           | <0.001* |
| Total cholesterol, mmol/L | 4.63 ± 1.20       | 3.82 ± 1.30           | <0.001* |
| Triglyceride, mmol/L | 2.07 ± 1.56                   | 1.72 ± 0.99           | 0.002*  |
| HDL-C, mmol/L        | 1.07 ± 0.31                   | 1.05 ± 0.28           | 0.507*  |

**TABLE 3: Comparison of lipid parameters between hospital admission and follow-up**

* Paired t-test.

HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; SD = standard deviation.

The therapeutic target of LDL-C < 1.8 mmol/L (<70 mg/dl), according to the ESC/EAS guidelines [22], was achieved in 45 (33.08%) patients. The NSTEMI group had the most effective treatment, with 20 (40%) patients meeting the therapeutic aim. In the UA group, the target was achieved in 12 (55.29%) patients, followed by only 13 (25%) patients with STEMI.

**Treatment modalities and procedures performed**

In terms of pharmacological therapy administered during hospitalization, all patients received lipid-lowering agents. Overall, 394 (96.59%) patients were managed with atorvastatin or rosuvastatin (Figure 1).
The rate of statin use during hospitalization includes dosages from 10 to 80 mg/day. Furthermore, the largest proportion of doses administered was 40 mg/dl (51.72%), followed by 20 mg/dl (46.15%) (Figure 2). Among females, rosuvastatin treatment (46.77%) was predominantly administered compared to males, who were mostly treated with atorvastatin (49.49%, P = 0.010). During follow-up, patients treated with 40 mg/day of atorvastatin had significantly lower average levels of LDL (P < 0.001), TC (P < 0.001), and TG (P = 0.023) than those treated with 20 mg/day of atorvastatin (Table 4).
In contrast, the mean lipid levels in patients treated with 20 mg/day of rosuvastatin at follow-up were significantly lower than those in patients treated with 40 mg/day of rosuvastatin: LDL (P < 0.001), TC (P < 0.001), and TG (P = 0.015). There was no significant difference in HDL levels throughout follow-up compared to admission values with either medication (P > 0.05).

Regarding procedures performed during hospitalization, electrocardiography followed by echocardiography were the most common procedures performed during hospital stay (98.37% and 96.42%, respectively). For invasive procedures, angiography and PCI were performed in 77.72% and 61.95% of the patients, respectively. In contrast, CABG was performed in only 4.39% of patients. In terms of ACS type, PCI was used more frequently in patients with STEMI than in those with NSTEMI/UA (P < 0.001) (Figure 3).
Males underwent catheterization more often than females (46.84% of males compared to 34.67% of females, \( P = 0.020 \)).

**Echocardiography findings**

For 573 out of the 615 study records, information on LVEF evaluated by left ventriculography or echocardiogram during the index hospitalization was available. The overall midpoint LVEF of the study was 47 ± 12.8%. It was divided by the dysfunctional severity shown in Table 5.

| Variables                  | Overall     | STEMI       | NSTEMI      | UA          | P-value |
|----------------------------|-------------|-------------|-------------|-------------|---------|
| LVEF, mean ± SD            | 47.01 ± 12.76 | 43.87 ± 10.89 | 46.84 ± 13.10 | 51.73 ± 13.42 | <0.001† |
| Hyperdynamic (>70%), n (%) | 18 (3.14)   | 2 (0.92)    | 4 (1.96)    | 12 (7.95)   |         |
| Normal (50-70%), n (%)     | 247 (43.11) | 60 (27.52)  | 103 (50.49) | 84 (55.63)  |         |
| Left ventricular dysfunction, n (%) | <0.001* |         |            |             |         |
| Mild (40-49%)              | 146 (25.48) | 84 (38.53)  | 38 (18.63)  | 24 (15.89)  |         |
| Moderate (30-39%)          | 115 (20.07) | 59 (27.06)  | 33 (16.18)  | 23 (15.23)  |         |
| Severe (<30%)              | 47 (8.20)   | 13 (5.96)   | 26 (12.74)  | 8 (5.30)    |         |

**TABLE 5: Assessment of left ventricular ejection fraction during hospitalization**

* Chi-square; † one-way ANOVA test.

LVEF = left ventricular ejection fraction; SD = standard deviation; STEMI = ST-segment elevation myocardial infarction; NSTEMI = non-ST-segment elevation myocardial infarction; UA = unstable angina.

Hyperdynamic LVEF was mostly noted in the UA group. In contrast, the incidence of mild and moderate left ventricular (LV) dysfunction was higher in the STEMI group, while that of severe dysfunction was higher in the NSTEMI group \( (P < 0.001) \). Females who presented with abnormal LVEF mostly had moderate LV dysfunction (40%), whereas males commonly had mild LV dysfunction (48.34%, \( P < 0.001 \)). The high-risk (class III) obesity group showed a significantly higher mean ejection fraction than the normal weight group \( (P = 0.038) \) (Figure 4).
Outcomes

Most of the patients (99.5%) recovered and were discharged from the CCU without adverse hospital events. The most common adverse event was reinfarction in 108 patients (17.6%) (Figure 5).

The rate of reinfarction was significantly higher among patients on lipid-lowering medications before their first hospital admission than among those who were not on medication (22.97% and 10.61%, respectively, \( P = 0.012 \)).

A total of 100 (16.26%) patients were readmitted to the CCU, and most of the readmissions were within 12 months, usually one to two months, after the first admission. The readmitted patients were mainly diabetic and hypertensive and between 55 and 64 years old. The readmission rate was higher among patients diagnosed with NSTEMI/UA during the first admission (Figure 6).
FIGURE 6: Number of coronary care unit readmissions for patients admitted in 2017 with the acute coronary syndrome and followed up until 2018

STEMI = ST-segment elevation myocardial infarction; NSTEMI = non-ST-segment elevation myocardial infarction; UA = unstable angina.

The readmission percentage was higher among females than among males (19.35% and 15.47%, respectively). Patients on lipid-lowering medications before hospital admission had a higher percentage of readmission than medically free patients (20.27% and 9.49%, respectively, P = 0.014). NSTEMI was the most common presentation among all readmissions.

Second admission

At the time of the second ACS hospital admission, the mean LDL-C (P < 0.001) and TC (P < 0.001) readings were considerably lower than those at the time of the first admission; in contrast, TG levels were higher during the second admission. Compared to the previous admission, there was a minor increase in TG, compared with HDL levels that slightly decreased (Table 6).

| Variables                  | Mean ± SD   | P-value |
|----------------------------|-------------|---------|
| LDL, mmol/L                | 2.21 ± 0.95 | <0.001  |
| Total cholesterol, mmol/L  | 3.74 ± 1.17 | <0.001  |
| Triglyceride, mmol/L       | 2.06 ± 1.35 | 0.496   |
| HDL, mmol/L                | 0.98 ± 0.26 | 0.092   |

TABLE 6: Lipid profile during second hospital admission

HDL = high-density lipoprotein; LDL = low-density lipoprotein; SD = standard deviation.

The most commonly prescribed lipid-lowering medication during the second admission was atorvastatin (61.22%), followed by rosuvastatin (37.76%) and simvastatin (1.02%). Of the 100 readmitted patients, a small percentage (4.06%) suffered another ACS episode in 2017 and 2018.

Discussion

Demographics and characteristics

Our study findings suggest that ACS was more prevalent in males. This result is consistent with a local prospective registry study that showed that the majority of their samples were males [24]. Another study in
Saudi Arabia’s southern region found that the frequency of CAD in males was higher than in females [10]. This suggests that males are at a higher risk of suffering from ACS due to the high prevalence of dyslipidemia, smoking, hypertension, and DM [25]. Further, STEMI in our study occurred more frequently in males, and the results are consistent with a study done in Sri Lanka, where the highest proportion of patients with STEMI was males [26]. Moreover, NSTEMI and UA were more prevalent in females, similar to a local study conducted in the southwest region [27]. This can be explained by sex differences in thrombotic and fibrinolytic activities [28].

The usual age groups at presentation in this study were between 55 and 64 years, followed by 45 and 54 years. These findings are in agreement with a prior study conducted in Saudi Arabia’s northern region, which showed that most of the cases of ACS were found among people in the 56-65 years and 46-55 years age group [29]. In contrast, the EuroHeart ACS survey conducted in a broad region in Europe and the Mediterranean Basin showed that most patients were between 65 and 74 years [30]. However, this survey did not include Saudi Arabia, and the average age of our study participants at the time of presentation was a decade younger than that reported globally. This might be due to various reasons, including a lack of evaluation by healthcare workers and inadequate understanding of primary care physicians regarding treatment, advanced therapies, and new technologies to aid in managing cardiovascular risk factors [31].

In addition, an increase in urbanization in Saudi Arabia may have profound implications for healthcare services and resource utilization, as well as the accessibility of healthcare facilities [31]. All aforementioned factors may contribute to poor risk factor management and the onset of ACS at a younger age.

Medical history and coronary risk factors

Concerning patients’ medical history, DM, dyslipidemia, and hypertension were the most frequent CAD risk factors. This is in agreement with previous local studies that showed that the majority of patients with ACS had DM, hypertension, and dyslipidemia [32]. In contrast, a study conducted in India discussing ACS-related risk factors within a population reported that DM and hypertension affected a smaller proportion of patients compared to our study [33]. Furthermore, obesity was a significantly common risk factor in our study, accounting for approximately one-quarter of cases, compared with a minority of cases observed in a study conducted in Europe addressing the impact of age on obesity in relation to ACS [34]. This variation suggests that a sedentary lifestyle, adopting a Western-pattern diet, and less regular exercise or physical activity have increased the prevalence of obesity in Saudi Arabia [35]. This established a link with the development of DM, dyslipidemia, and hypertension [36].

In this study, the occurrence of previous ACS episodes was higher among female patients; previous studies showed a lower incidence in female patients [37]. The high mean age of female patients in both studies is a reasonable explanation (64 and 73 years) [37]. Moreover, this could be attributed to the hormonal changes in menopause, which is a risk factor for ACS in females [38].

Lipid parameters at admission

Regarding the lipid profile, we found that the mean of lipid parameters at admission varied depending on sex. Males had significantly higher LDL-C, TC, and TG levels, whereas HDL-C values were higher in female patients. Our findings are consistent with those of prior studies [39-41]. In contrast, previous studies in a Polish population showed that high LDL-C levels were significantly higher in females compared to males (P = 0.035); additionally, other lipid profile components were found to be less controlled in females than in males [42]. Moreover, according to Esteghamati et al., female patients had greater mean TG levels than male patients [43]. These disparities support the theory that genetic differences could explain variances in sex inequality, body fat distribution, lifestyle, and nutritional habits among the nation-states where the research was conducted [39].

Lipid parameters at follow-up

Although lipid-lowering statins were administered to most of the participants in this study at the time of discharge, only 161 of 615 participants returned to the hospital for a follow-up visit. At follow-up, the mean LDL-C, TC, and TG levels were significantly lower than those at admission. Our findings are consistent with those of numerous clinical trials that have demonstrated the benefit of statin therapy with respect to cardiovascular events among patients with ACS [44]. In patients with ACS, dyslipidemia is common and is considered a treatment focus, with clinical trials and meta-analyses increasingly supporting early, intense, and ongoing statin treatment in patients with ACS, as it reduces coronary plaque burden and lowers the risk of cardiovascular mortality and morbidity [45].

The therapeutic target of LDL-C < 1.8 mmol/L (<70 mg/dl) was achieved in only 45 of 161 patients in our study. This is consistent with prior research findings in patients with ACS, which revealed that the goal of LDL-C ≤ 1.8 mmol/L (≤70 mg/dl) was achieved in less than half of the patients [46]. Furthermore, according to another study, only 44 of 242 patients with ACS achieved an LDL-C < 1.8 mmol/L (<70 mg/dl) [47]. Several studies indicated that lowering LDL-C to <1.8 mmol/L (<70 mg/dl) as part of secondary prevention improves the prognosis of individuals with ACS [48]. Lowering LDL-C decreases cardiovascular morbidity and mortality in individuals with atherosclerotic CVD, with a therapeutic effect corresponding to the extent of
Lipid-lowering therapy

In our study, most patients were prescribed atorvastatin (20 or 40 mg/day) or rosuvastatin (20 or 40 mg/day) during hospitalization. This is in line with the literature as atorvastatin and rosuvastatin are the two most commonly recommended medications for hypercholesterolemia and are regularly used to treat individuals with ACS [52]. Cholesterol guidelines of the American College of Cardiology and American Heart Association have designated atorvastatin doses of 70-100 mg/day or rosuvastatin doses of 20-40 mg/day as high-intensity statins [53]. A previous meta-analysis of individual participant data from randomized trials reported that compared with less intensive regimens, high-intensity statins significantly decreased (15% reduction) major coronary events, with substantial reductions in the incidence of coronary mortality or non-fatal myocardial infarction of 13% [54]. This is in line with expert recommendations, which recommend initiating intense lipid-lowering therapy during the first one to four days following ACS [55].

Furthermore, earlier studies reported that doubling the dose of a statin (atorvastatin 40 mg/day to 80 mg/day) will facilitate a further (6%) reduction in LDL-C, and given the well-established link between lowered LDL-C and outcomes, an 80 mg/day dose will further improve outcomes [56-59]. Additionally, the results of previously completed trials supported the favorable safety profile of atorvastatin at the highest dose [60]. Moreover, the medical team generally determines the proper statin dose in the hospital. In specific situations, such as cases of previous intolerance or abnormal liver function tests, secondary or primary care teams may up-titrate the dose as tolerated, from an initial low dose after discharge [59].

Procedures performed

We found that procedures performed on patients in CCU and those with cardiac diseases included the use of an ECG in most cases. An ECG is used to display the heart’s electrical activity to establish the diagnosis [61]. In addition, cardiac biomarkers are essential indicators of heart damage. In ACS, an increase in these cardiac enzymes provides further diagnostic relevance [62]. Previous studies have suggested that ECGs proved invaluable in the CCU setting [63], as was the case in the CCU of KAUH.

Our findings imply that invasive procedures, such as PCI, are commonly used in the CCU. A study published in the International Journal of Cardiology concluded that PCI was the most appropriate measure for patients with STEMI, as the majority of patients over 60 years of age underwent the procedure [64]. PCI was used as both a diagnostic and therapeutic tool, further justifying the critical nature of this intervention in cases of myocardial infarction [65,66]. It is important to note that PCI is also used as a treatment option for patients with ACS because placing a stent in the coronary arteries may lower the risk of mortality by approximately 30% [67].

Echocardiography findings

Echocardiography was performed in almost all patients in our study for the determination of LVEF [68]. Echocardiography is considered reliable for establishing ACS prognosis [69]. The patients in our study demonstrated varying degrees of LV function, as many of them had different risk factors influencing their ejection fraction, and our figures were comparable to those of other studies [69].

Regarding the type of ACS, patients with STEMI, in terms of disease severity, had varying levels of LVEF. However, the patients with NSTEMI in our study were classified as having the worst result, with an ejection fraction < 30%. Moreover, a 2020 study published in the European Journal of Preventive Cardiology found that the number of patients with STEMI with a <45% ejection fraction was significantly higher than patients with NSTEMI in both sexes [70]. These data suggest the presence of unique environmental and genetic risk factors across patients in different countries [71,72]. Our patients have displayed intriguing outcomes that may not have been considered possible before conducting our study.

These discrepancies might seem unrealistic at first glance; however, with further understanding of the different risk factors in patients with ACS, it becomes clear that patients in the CCU exhibit mixed results that are open for interpretation. Overall, the importance of invasive and non-invasive procedures in the CCU of KAUH cannot be underestimated, as they prove to be vital tools in guiding physicians toward the correct diagnosis and treatment of cardiac patients.

Hospital outcomes

Our study indicates a high recovery rate from ACS. Of the patients in our study, 99.5% of patients recovered and were discharged compared to 97.2% of patients who recovered and were discharged from a secondary care center in the southern region of Saudi Arabia during the same period as our study [10]. In another study in Kerala, India, the recovery rate without hospital adverse events was 94.3% [73]. Based on a previous study conducted at Tehran Medical Center, the mortality rate was significantly higher in a low socio-economic
status (SES) group than in a high SES group [74]; this emphasizes that SES may play a major role in these disparities.

Our results showed that reinfarction was the most common adverse event in the patients. The proportion of patients readmitted to the CCU was mainly patients with diabetes and hypertension. A previous study conducted in a medical center in Sweden showed that the most common adverse event among patients with diabetes was reinfarction and concluded that the infarction occurrence rate is doubled in diabetic patients compared to non-diabetic patients [75]. Similar observations have been made in previous studies [76-78]. According to a previous study, patients with diabetes were more likely to develop ischemic cardiomyopathy than those without diabetes [78]. Hypertension is common in patients with diabetes, and a previous study in Switzerland revealed that in a one-year follow-up of patients with ACS, patients with hypertension had worse unmodified outcomes with 65% more chances of developing reinfarction than patients without hypertension [79]. It has been shown that in patients with diabetes and hypertension, the prevalence of macro-vascular consequences (myocardial infarction and stroke) is much higher than in those without hypertension [80].

Our research data show that the percentage of readmission among females was higher than that among males, a finding similar to that obtained in a study conducted in multiple centers worldwide that found a higher percentage of readmission in females than males [81]. A previous study showed that cardiovascular medications might have different effects on men and women because of variations in body composition, fluctuations in endogenous sex hormone levels (female monthly cycle and gestation), the pharmacokinetics/pharmacodynamics characteristics of some medicines, or the use of hormone replacement treatment or oral contraceptives [41,82].

**Limitations**

There are certain limitations to our study. This research was a retrospective analysis with concerns regarding the completeness and accuracy of the data recorded. In addition, this was a single-center study; hence, there are potential differences compared with other regions or countries. The follow-up period in this study was not equivalent for all patients; more precise timing is required to further support the findings regarding lipid parameters at follow-up obtained from this study. We conducted this study among inpatients of a tertiary teaching center. As the quality of management and clinical outcomes are not ubiquitous throughout Saudi Arabia, our results could only reflect a higher level of medical care than other studies conducted in the same region.

**Conclusions**

In this study, we included patients with ACS admitted to the CCU at KAUH in 2017 and aimed to analyze patient demographics, risk factors, investigations, and outcomes. Our results revealed that a significant proportion of patients were a decade younger than what has been recorded worldwide. The most prevalent final diagnosis was a STEMI. Moreover, hypertension, DM, and dyslipidemia were the most frequent modifiable cardiovascular risk factors. Reinfarction was the most common adverse event, with a strong association with hypertension and DM.

Nevertheless, the recovery rate in this study was higher than that in other countries. At follow-up, many patients did not meet the target lipid levels. The younger presentation age of our population needs critical consideration and more strict preventive interventions, such as lifestyle modifications and evidence-based treatments for CVD risk factors to decrease ACS events, thereby, decreasing the burden on the CCUs as well as CVD morbidity and mortality. However, the rate of ACS admission was much lower during the COVID-19 pandemic period, with a significant link with COVID-19 prevalence. As a result, we looked at patients admitted during 2017 to avert the pandemic’s impact on healthcare systems worldwide. In addition, Saudi Arabia is a country with rapidly evolving cardiovascular demographics; therefore, more research is necessary to understand the presentations, risk factors, management settings, and clinical outcomes of ACS at the regional level since they may differ across regions and with time.

**Additional Information**

**Disclosures**

**Human subjects:** Consent was obtained or waived by all participants in this study. Research Ethics Committee (REC), Unit of Biomedical Ethics, King Abdulaziz University Hospital issued approval 299-20. The study protocol strictly followed standard clinical guidelines and was approved by the Research Ethics Committee (REC) of King Abdulaziz University Hospital (Reference No.: 299-20). Due to the deidentified nature of the databases, written informed consent was not required; however, each patient’s medical record number was identified and patient confidentiality was preserved. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
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References

1. World Health Organization. Cardiovascular diseases. (2021). Accessed: May 10, 2022: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1.
2. Ralapanava U, Sivakanesan R: Epidemiology and the magnitude of coronary artery disease and acute coronary syndrome: a narrative review. J Epidemiol Glob Health. 2021, 11:69-77. 10.2991/jegh.k.202117.001
3. Overhaugh KJ: Acute coronary syndrome. Am J Nurs. 2009, 109:42-52. 10.1097/01.NAJ.0000351508.39509.e2
4. Lippi G, Sanchis-Gomar F, Cervellin G: Chest pain, dyspnea and other symptoms in patients with type 1 and 2 myocardial infarction. A literature review. Int J Cardiol. 2016, 215:20-2. 10.1016/j.ijcard.2016.04.045
5. Sanchis-Gomar F, Perez-Quilis C, Leichzik R, Lucia A: Epidemiology of coronary heart disease and acute coronary syndrome. Ann Transl Med. 2016, 4:256. 10.21037/atm.2016.06.53
6. Traina MI, Almahmeed W, Eidris A, Murat Tuzu E: Coronary heart disease in the Middle East and North Africa: current status and future goals. Curr Atheroscler Rep. 2017, 19:24. 10.1007/s11883-017-0659-9
7. Ministry of Health - Kingdom of Saudi Arabia. Cardiovascular diseases cause 42% of non-communicable diseases deaths in the Kingdom. (2015). Accessed: May, 10 2022: https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/News-2015-10-30-002.aspx.
8. Mabry RM, Reeves MM, Eklin EG, Owen N: Evidence of physical activity participation among men and women in the countries of the Gulf Cooperation Council: a review. Obes Rev. 2010, 11:457-64. 10.1111/j.1467-789X.2009.00655.x
9. Mashat AA, Subhi AH, Bahlaidkar MA, et al.: Atrial fibrillation: risk factors and comorbidities in a tertiary center in Jeddah, Saudi Arabia. Int J Gen Med. 2019, 12:71-7. 10.2147/IJGM.S185524
10. Al-Ghamdi MA: Morbidity pattern and outcome of patients admitted in a coronary care unit: a report from a secondary hospital in southern region, Saudi Arabia. J Community Hosp Intern Med Perspect. 2018, 8:191-4. 10.1080/20009666.2018.1500421
11. Amit G, Goldman S, Ore L, Low M, Kark ID: The association between hospital department, medical treatment and outcome in acute myocardial infarction. Isr Med Assoc J. 2003, 5:255-9.
12. Chapman BL: Effect of coronary care on myocardial infarct mortality. Br Heart J. 1979, 42:386-95. 10.1136/hrt.42.4.386
13. Fagin ID, Anandiah KM: The coronary care unit and mortality from myocardial infarction: a continued evaluation. J Am Geriatr Soc. 1971, 19:675-96. 10.1111/j.1552-5415.1971.tb0255x.
14. Fuster V: Myocardial infarction and coronary care units. J Am Coll Cardiol. 1999, 34:1851-3. 10.1016/S0735-1097(99)00496-9
15. Karlson BW, Herlitz J, Wiklund O, Pettersson P, Hjalmarson A: Characteristics and prognosis of patients with acute myocardial infarction in relation to whether they were treated in the coronary care unit or in another ward. Cardiology. 1992, 81:134-44. 10.1159/000175788
16. Killip T 3rd, Kimball FT: Treatment of myocardial infarction in a coronary care unit. A two year experience with 250 patients. Am J Cardiol. 1967, 20:457-64. 10.1016/0002-9149(67)90025-9
17. Lawson-Matthew PJ, Wilson AT, Woodward PA, Chaner KS: Ununsatisfactory management of patients with myocardial infarction admitted to general medical wards. JR Coll Physicians Lond. 1992, 28:49-51.
18. Rotstein Z, Mandelweiz L, Lavi B, Eldar M, Gottlieb S, Hod H: Does the coronary care unit improve prognosis of patients with acute myocardial infarction? A thrombolytic era study. Eur Heart J. 1999, 20:813-8. 10.1053/ehj.1998.1452
19. Sagie A, Rotenberg Z, Weinberger J, Fuchs J, Agmon J: Acute transmural myocardial infarction in elderly patients hospitalized in the coronary care unit versus the general medical ward. J Am Geriatr Soc. 1987, 35:915-9. 10.1111/j.1552-5415.1987.tb02291.x
20. Abullulimen-Iyoha BI, Pooboni SK, Vuppali NKK: Morbidity pattern and outcome of patients admitted into a pediatric intensive care unit in India. Indian J Clin Med. 2014, 5:13902. 10.4107/IJCM.S13902
21. Hypercholesterolemia. (2021). Accessed: August 28, 2021: https://bestpractice.bmj.com/topics/en-gb/170/investigations.
22. Catapano AL, Graham I, De Backer G, et al.: 2016 ESC/EAS guidelines for the management of dyslipidaemias. Eur Heart J. 2016, 37:2999-3058. 10.1093/eurheartj/ehw272
23. Left ventricular ejection fraction (LVEF) assessment (outpatient setting). (2014). Accessed: August 28, 2021: https://www.who.int/tools-and-practice-support/practical-clinical-toolkits/-/media/IE4D8FP986/9D14F538218FE642FBA221.ashx.
24. Abhilabh EF, Hersi A, Alfaieh H, et al.: Baseline characteristics, management practices, and in-hospital outcomes of patients with acute coronary syndromes: results of the Saudi project for assessment of coronary events (SPACE) registry. J Saudi Heart Assoc. 2011, 23:235-9. 10.1016/j.jsha.2011.05.004
25. Bhatli MA, Kayani AM, Samore NA: Frequency of risk factors in male patients with acute coronary care unit. J Coll Physicians Surg Pak. 2011, 21:271-5.
26. Galappaththy P, Ratnadasaarachchi VR, Ranasinghe P, et al.: Management, characteristics and outcomes of patients with acute coronary syndrome in Sri Lanka. Heart. 2018, 104:1424-31. 10.1136/heartjnl-2017-312404
27. Assisi AS: Gender differences in clinical presentation and management of patients with acute coronary syndrome in southwest of Saudi Arabia. J Saudi Heart Assoc. 2011, 23:153-41. 10.1016/j.jsha.2011.01.007
28. MacCallum PK, Cooper JA, Howarth DJ, Meade TW, Miller GJ: Sex differences in the determinants of fibrinolytic activity. Thromb Haemost. 1998, 79:287-90. 10.1055/s-0037-1614950
29. Alhassan S, Ahmed H, Almutlaq B, et al.: Risk factors associated with acute coronary syndrome in northern Saudi Arabia. J Cardiol Curr Res. 2017, 8:00281. 10.15406/jcrr.2017.08.00281

30. Rosengren A, Wallentin L, Simoons M, Gitt AK, Behar S, Battler A, Hasdal D: Age, clinical presentation, and outcome of acute coronary syndromes in the EuroHeart acute coronary syndrome survey. Eur Heart J. 2006, 27:789-95. 10.1093/eurheartj/ehi774

31. Ahmed AM, Harsi A, Mashhooud W, Arafah MR, Abreu PC, Al Rowaily MA, Al-Mallah MH: Cardiovascular risk factors burden in Saudi Arabia: the Africa Middle East Cardiovascular Epidemiological (ACE) study. J Saudi Heart Assoc. 2017, 29:235-43. 10.1016/j.jsha.2017.03.004

32. Harsi A, Al-Habib K, Al-Faleh H, et al.: Gender inequality in the clinical outcomes of equally treated acute coronary syndrome patients in Saudi Arabia. Ann Saudi Med. 2013, 33:339-46. 10.15170/2569-4947.2013.339

33. Yavuz P, Joseph D, Joshi P, Saldi P, Jha B, Gupta J: Clinical profile & risk factors in acute coronary syndrome. J Natl Commun Med. 2010, 1:150-1.

34. Narasimhan B, Ho K, Wu L, et al.: Impact of age on the obesity paradox in acute coronary syndrome: a nationwide analysis. Eur Heart J. 2020, 41:ehaa946.1559. 10.1093/eurheartj/ehaa946.1559

35. Al-Raddadi R, Bahijri SM, Jambi HA, Ferns G, Tuomilehto J: The prevalence of obesity and overweight, associated demographic and lifestyle factors, and health status in the adult population of Jeddah, Saudi Arabia. Ther Adv Chronic Dis. 2019, 10: 10.1177/2040622319878997

36. Nguyen NT, Magno CP, Lane KT, Hinojosa MW, Lane JS: Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity: findings from the National Health and Nutrition Examination Survey. 1999 to 2004. J Am Coll Surg. 2008, 207:928-34. 10.1016/j.jamcollsurgery.2008.08.022

37. Alfredsson J, Stenestrund U, Wallentin L, Swahn E: Gender differences in management and outcome in non-ST-elevation acute coronary syndrome. Heart. 2007, 93:1357-62. 10.1136/hrt.2006.102012

38. Haider A, Bengs S, Luzi J, Osto E, Siller-Matula M, Maka T, Gebhard C: Sex and gender in cardiovascular medicine: presentation and outcomes of acute coronary syndrome. Eur Heart J. 2020, 41:1528-36. 10.1093/eurheartj/ehz898

39. Abdelaziz A, Fawzy M: Prevalence and pattern of dyslipidemia in acute coronary syndrome patients admitted to medical intensive care unit in Zagazig University Hospital, Egypt. Zagazig University Med J. 2020, 4, 10.21608/zumj.2014.4401

40. Seidell JC, Cigolini M, Charzew ska J, et al.: Fat distribution and gender differences in serum lipids in men and women from four European communities. Atherosclerosis. 1991, 87:203-10. 10.1016/0021-9150(91)90022-U

41. Parvin D, Baul SK, Hossain SB, Munshi S, Hadizuzzaman M, Fatema K: Pattern and prevalence of dyslipidemia among patients with acute coronary syndrome admitted in a tertiary level hospital. Bangladesh Heart J. 2019, 34:51-6. 10.3329/bjh.v34i1.41905

42. Setny M, Jankowski P, Krzykova A, et al.: Management of dyslipidemia in women and men with coronary heart disease: results from POLASPIRE study. J Clin Med. 2021, 10:2594. 10.3390/jcm10122594

43. Esteghamati A, Abbasil M, Nakhaivani M, Yousefizadeh A, Basa AP, Asfar H: Prevalence of diabetes and other cardiovascular risk factors in an Iranian population with acute coronary syndrome. Cardiovasc Diabetol. 2006, 5:15. 10.1186/1475-2840-5-15

44. Dohi T, Miyauchi K, Okazaki S, et al.: Early intensive statin treatment for six months improves long-term clinical outcomes in patients with acute coronary syndrome (Extended-ESTABLISH trial): a follow-up study. Atherosclerosis. 2010, 210:497-502. 10.1016/j.atherosclerosis.2009.12.001

45. Fujisue K, Tsuchita K: Current status of lipid management in acute coronary syndrome. J Cardiol. 2017, 70:101-6. 10.1016/j.jjcc.2017.02.004

46. Melloni C, Shah BR, Ou FS, et al.: Lipid-lowering intensification and low-density lipoprotein cholesterol achievement from hospital admission to 1-year follow-up after an acute coronary syndrome event: results from the Medications Applied and Sustained Over Time (MAINTAIN) registry. Am Heart J. 2010, 160:1121-9. el. 10.1016/j.ahj.2010.09.008

47. Andrikopoulos G, Tzeis S, Nikas N, et al.: Short-term outcome and attainment of secondary prevention goals in patients with acute coronary syndrome—results from the countrywide TARGET study. Int J Cardiol. 2013, 168:922-7. 10.1016/j.ijcard.2012.10.049

48. Hobbs FD, Banach M, Mikhailidis DP, Malhotra A, Cawpells S: Is statin-modified reduction in lipids the most important preventive therapy for cardiovascular disease? A pro/con debate. BMC Med. 2016, 14:4. 10.1186/s12916-016-0550-3

49. Baigent C, Blackwell L, Emberson J, et al.: Efficacy and safety of more intensive lowering of LDL-cholesterol: a meta-analysis of data from 170,200 participants in 26 randomised trials. Lancet. 2010, 376:1670-81. 10.1016/S0140-6736(10)61350-5

50. Koskinas KC, Siontis GC, Piccolo R, Mavridis D, Räber L, Mach F, Windecker S: Effect of statins and non-statin LDL-lowering medications on cardiovascular outcomes in secondary prevention: a meta-analysis of randomized trials. Eur Heart J. 2018, 39:1172-80. 10.1093/eurheartj/ehx566

51. Schiefe F, Farnier M, Kempf M, Bruckert E, Ferezieres F: A consensus statement on lipid management after acute coronary syndrome. Eur Heart J Acute Cardiovasc Care. 2018, 7:532-43. 10.1002/accc.20011

52. Khurana S, Gupta S, Bhalla H, Nandwani S, Gupta V: Comparison of anti-inflammatory effect of atorvastatin with rosuvastatin in patients of acute coronary syndrome. J Pharmacol Pharmacother. 2015, 6:150-5. 10.4103/0976-500X.162011

53. Stone NJ, Robinson JG, Lichtenstein AH, et al.: 2015 ACC/AHA guideline on the treatment of blood cholesterol to reduce atherosclerotic cardiovascular risk in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2014, 65:2889-934. 10.1016/j.jacc.2015.11.002

54. Cholesterol Treatment Trials’ Collaboration: Efficacy and safety of statin therapy in older people: a meta-analysis of individual participant data from 28 randomised controlled trials. Lancet. 2019, 393:407-15. 10.1016/S0140-6736(18)31942-1

55. Reiner Z, Catapano AL, De Backer G, et al.: ESC/EAS guidelines for the management of dyslipidaemias: the Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and the
European Atherosclerosis Society (EAS). Eur Heart J. 2011, 32:1769-818. 10.1093/eurheartj/ehr158

Javed U, Deedwania PC, Bhatt DL, et al.: Use of intensive lipid-lowering therapy in patients hospitalized with acute coronary syndrome: an analysis of 65,396 hospitalizations from 544 hospitals participating in Get With The Guidelines: (GWGT). Am Heart J. 2011, 161:418-42.e1-5. 10.1016/j.ahj.2010.12.014

Jones PH, McKeeney JM, Karalis OG, Downey J: Comparison of the efficacy and safety of atorvastatin initiated at different starting doses in patients with dyslipidemia. Am Heart J. 2005, 149:e1-8. 10.1016/j.ahj.2004.07.005

Kaul U, Varma J, Kahali D, et al.: Post-marketing study of clinical experience of atorvastatin 80 mg vs 40 mg in Indian patients with acute coronary syndrome— a randomized, multi-centre study (CURE-ACS). J Assoc Physicians India. 2015, 61:97-101.

Kerr AI, Minala S, Lee M, White HD: Utilisation and maintenance of high-intensity statins following acute coronary syndrome and coronary angiography: opportunities to improve care (ANZACS-QI 26). NZ Med J. 2020, 133:21-40.

Newman C, Tsai J, Szarek M, Luo D, Gibson E: Comparative safety of atorvastatin 80 mg versus 10 mg derived from analysis of 49 completed trials in 14,236 patients. Am J Cardiol. 2006, 97:61-7.

10.1016/j.amjcard.2005.07.108

Meyers HP, Bracey A, Lee D, et al.: Comparison of the STElevation myocardial infarction (STEMI) vs. NSTEMI and occlusion MI (OMI) vs. NOMI paradigms of acute MI. J Emerg Med. 2021, 60:273-84. 10.1016/j.jemermed.2020.10.026

Cullen L, Than M, Brown AF, et al.: Comprehensive standardized data definitions for acute coronary syndrome research in emergency departments in Australasia. Emerg Med Australas. 2010, 22:35-55. 10.1111/j.1742-6723.2010.01256.x

Knoery CR, Bond R, Iihihara A, et al.: SPICED-ACS: study of the potential impact of a computer-generated ECG diagnostic algorithmic certainty index in STEMI diagnosis: towards transparent AL. J Electrocardiol. 2019, 57S:S86-91. 10.1016/j.jelectrocard.2018.09.006

Li R, Yan BP, Dong M, et al.: Quality of life after percutaneous coronary intervention in the elderly with acute coronary syndrome. Int J Cardiol. 2012, 155:90-6. 10.1016/j.ijcard.2010.09.050

Alcock RF, Yong AS, Ng AC, et al.: Acute coronary syndrome and stable coronary artery disease: are they so different? Long-term outcomes in a contemporary PCI cohort. Int J Cardiol. 2015, 167:1543-6. 10.1016/j.ijcard.2012.04.011

Roe MT, Messenger JC, Weintraub WS, et al.: Treatments, trends, and outcomes of acute myocardial infarction and percutaneous coronary intervention. J Am Coll Cardiol. 2010, 56:254-63. 10.1016/j.jacc.2010.05.008

Mehta SR, Wood DA, Storey RF, et al.: Complete revascularization with multivessel PCI for myocardial infarction. N Engl J Med. 2019, 381:1411-21. 10.1056/NEJMoa1907775

Andersen OS, Smiseth OA, Dokainish H, et al.: Estimating left ventricular filling pressure by echocardiography. J Am Coll Cardiol. 2017, 69:1957-48. 10.1016/j.jacc.2017.01.058

Pereselstein Brezinov O, Klempfner R, Zekry SB, Goldenberg I, Kuperstein R: Prognostic value of ejection fraction in patients admitted with acute coronary syndrome: a real world study. Medicine (Baltimore). 2017, 96:e6226. 10.1016/j.md.2017.08.006

Hay M, Stenil J, Martin C, Brennan A, Dinh DT, Lefkovits J, Zaman S: Sex differences in optimal medical therapy following myocardial infarction according to left ventricular ejection fraction. Eur J Prev Cardiol. 2020, 27:2348-50. 10.1016/j.ejpc.2020.03.005

Notara V, Panagiotakos DB, Pitsavos CE: Secondary prevention of acute coronary syndrome. Socio-economic and lifestyle determinants: a literature review. Cent Eur J Public Health. 2014, 22:175-82. 10.21101/cejph.a5960

Vaara S, Tikkanen E, Parkkonen O, et al.: Genetic risk scores predict recurrence of acute coronary syndrome. Circ Cardiovasc Genet. 2016, 9:172-8. 10.1161/CIRCGENETICS.115.001271

Mohanan MP, Mathew R, Hariskrishan S, et al.: Presentation, management, and outcomes of 25 748 acute coronary syndrome admissions in Kerala, India: results from the Kerala ACS Registry. Eur Heart J. 2015, 34:121-9. 10.1093/eurheartj/ehv219

Abbasi SH, De Leon AP, Kassaian SE, et al.: Socioeconomic status and in-hospital mortality of acute coronary syndrome: can education and occupation serve as preventive measures? Int J Prev Med. 2015, 6:56. 10.4103/2008-7802.15266

Karlston BW, Herlitz J, Hjalmarson A: Prognosis of acute myocardial infarction in diabetic and non-diabetic patients. Diabet Med. 1995, 10:449-54. 10.1111/j.1464-5491.1995.tb0097x

Herlitz J, Malmberg K, Karlsson BW, Ryden L, Hjalmarson A: Mortality and morbidity during a five-year follow-up of diabetics with myocardial infarction. Acta Med Scand. 1988, 224:51-8. 10.1111/j.0955-682X.1988.tb16755.x

Ulvenstam G, Aberg A, Bergstrand R, et al.: Are different? Long-term outcomes in a contemporary PCI cohort. Int J Cardiol. 2019, 133:204-50. 10.1016/j.ijcard.2012.04.011

Erne P, Radovanovic D, Schoenenberger AW, Bertel O, Kaeslin T, Essig M, Gaspar JM: Impact of hypertension on the outcome of patients admitted with acute coronary syndrome. J Hypertens. 2015, 33:860-7. 10.1093/ hypertension/jhv003

8. 10.1093/hypertension/jhv003

Ferranmendi E, Cushman WC: Diabetes and hypertension: the bad companions. J Hypertens. 2015, 33:860-7. 10.1093/hypertension/jhv003

Pelletier R, Cheu J, Winters N, et al.: Sex differences in clinical outcomes after premature acute coronary syndrome. Can J Cardiol. 2016, 32:1447-53. 10.1016/j.cjca.2016.05.018

Tamargo J, Rosano G, Walth T, et al.: Gender differences in the effects of cardiovascular drugs. Eur Heart J Cardiovasc Pharmacother. 2017, 5:163-82. 10.1093/ehjcvp/pwy042