Original Article

Gender inequality in acute coronary syndrome patients at Omdurman Teaching Hospital, Sudan

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ABSTRACT

Background: Gender differences among patients with the acute coronary syndrome is still being debated, no research has been done on gender inequality among coronary syndrome patients in Sudan. **Objectives:** To study gender differences in presentation, management, and outcomes of acute coronary syndrome in Sudan. **Subjects and Methods:** This cross-sectional descriptive longitudinal study was conducted in Omdurman Teaching Hospital between July 2014 and August 2015. Patients were invited to sign a written informed consent form, were interviewed and examined by a physician, and then followed during their hospital stay. Information collected includes coronary risk factors, vital signs, echocardiography findings, arrhythmias, heart failure, cardiogenic shock, and death. The Ethical Committee of Omdurman Teaching Hospital approved the research. **Results:** A total of 197 consecutive acute coronary syndrome patients were included, 43.1% were females. A significant statistical difference was evident between males and females regarding the type of acute coronary syndrome, its presentation, and time of presentation to the hospital, smoking, and receipt of thrombolysis ($P < 0.05$). No differences were found with regard to age, hypertension, diabetes, family history of myocardial infarction, percutaneous coronary intervention, and in-hospital acute coronary complications ($P > 0.05$). **Conclusion:** Women were less likely to receive thrombolytic therapy, present with chest pain, and diagnosed with ST-segment elevation myocardial infarction. No gender differences were found in acute coronary syndrome risk factors apart from smoking, which was more common in males, and there were no differences between males and females as regards in-hospital complications.

Key words: Acute coronary syndrome, gender, inequality, Sudan

INTRODUCTION

Coronary artery disease is the leading cause of death in the developed world and one of the most deadly diseases in developing countries. The mortality was estimated at 7.3 million deaths while disability-adjusted life years were estimated at 58 million in the year 2001. Owing to increasing risk factors, the level seems to be rising worldwide.[1,2]

In Sudan, 12% of people die from cardiovascular diseases, which comes after noncommunicable diseases.[3] The actual figure may be higher because many deaths occur outside hospitals and go unrecorded.

Many studies have reported gender inequality with regard to acute coronary syndrome treatment and outcomes, in which females had fewer interventional procedures and increased in-hospital complications and mortality.[4] The reason for this difference in coronary artery outcomes between males and females is not certain. Whether this is due to basic clinical characteristics or the pathophysiological difference between males and females is uncertain.[5]

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Lifestyle changes toward a healthier diet, regular exercise, and cessation of smoking are necessary measures for the prevention of coronary artery disease in women. There is no documentation of the protective effect of hormone replacement therapy on postmenopausal female with coronary artery disease nor is there any beneficial effect of this on coronary events in healthy postmenopausal women. Thus, hormone replacement therapy is currently not recommended as prophylaxis for cardiovascular disease.[6]

Observational studies have demonstrated that guidelines for acute coronary syndrome are not followed in women. In contrast, some researchers have concluded that there are no differences in management and outcomes between males and females.[7,8]

In the light of this lack of agreement and the fact that Sudan is a vast country with 66.8% of its population living in rural areas, the presentation, and management of acute coronary syndrome patients may differ from Western countries. We conducted this research to assess gender differences in presentation, management, and outcomes for patients with acute coronary syndrome in Omdurman Teaching Hospital in Sudan.

SUBJECTS AND METHODS

This study was conducted at the Coronary Care Unit in Omdurman Teaching Hospital from July 2014 to August 2015. The study included 202 (125 males, and 87 females) consecutive patients; 5 patients with incomplete data were excluded. The diagnosis of ST-segment elevation myocardial infarction (STEMI), and non-ST-segment elevation acute coronary syndrome (unstable angina and non STEMI [NSTEMI] collectively) was based on the typical chest pain, electrocardiographic changes, and elevated cardiac biomarkers following American College of Cardiology Guidelines.[9] A cardiologist assistant collected the basic clinical information and cardiovascular risk factors including, hypertension, diabetes mellitus, family history of myocardial infarction, and smoking. The hospital course was recorded by the cardiologist. The presenting complaint, vital signs (pulse, blood pressure, and respiratory rate) were recorded and followed. The ejection fraction (EF) was registered by echocardiography, as was intramural thrombus, and EF was categorized to severe left ventricular (LV) dysfunction: (EF) <30%, moderate LV dysfunction: EF = 30–40%, mild LV dysfunction: EF = 40–55%, and normal LV function: EF > 55%.[10] Thrombolytic therapy and percutaneous coronary angioplasty (PCI) were recorded, and the patients were followed for the development of complications including arrhythmias, heart failure, cardiogenic shock,

and death. The following definitions were adopted for the purpose of this research – hypertension: Self-reported, on antihypertensive therapy, history of systolic blood pressure more than 140 mmHg, or diastolic blood pressure more than 90 mmHg; diabetes mellitus: Self-reported or being on oral hypoglycemic agents and/or insulin; current smoking: Cigarette, cigar, pipe, or smoking of shisha in the past year; family history of premature coronary artery disease: History of angina, myocardial infarction, or sudden cardiac death of first-degree relatives aged <65 years in females, and <55 years in males; cardiogenic shock: Persistent hypotension unresponsive to fluid administration and requirement for intravenous inotropic therapy or insertion of intra-aortic balloon pump; and heart failure: Shortness of breath on exertion and/or at rest, paroxysmal nocturnal dyspnea associated with clinical signs of pulmonary, and/or peripheral edema requiring treatment with diuretic therapy. Various parameters were then compared to males and females. All participants signed a written informed consent, and the Local Committee Approved the Research.

The Statistical Package for Social Science (SPSS) version 20 (IBM Corporation, Chicago, Illinois) was used for data analysis. Chi-square test was used to compare categorical data with $p < 0.05$ considered significant.

RESULTS

Of 197 acute coronary syndrome patients, 43.1% were females whose ages ranged from 30 to 70 years; women were younger than males with no significant statistical difference (55.3 ± 1.9 vs. 57.9 ± 1.1) $p = 0.225$. STEMI was more among males (57.1%) compared to females (35.2%) while NSTEMI was more common among women (64.8% vs. 42.9%) $p = 0.009$. Hypertension was found in 54.5% male and 55.2% female, $p = 0.052$. About 30% males were diabetics while diabetes mellitus was observed in 31.7% females, $p = 0.322$. The family history of myocardial infarction was present in 18.7% males and 22.3% females, $p = 0.438$. Smoking was reported by 1.2% females and 32.1% males, $p < 0.001$. In 62 (55.3%) and 43 (50.5%) Heart failure was present in 55.3% males and 50.5% females, $p = 0.047$. About 96% of females and 93.7% of males presented with chest paint, 82 (96.4%) women and 105 (93.7%) men, $p < 0.001$. Two-third of females and 55.3% of males reached the hospital later than 24 hours after the onset of pain [Table 1].

PCI was undertaken in only 7% of the females and 13.4% of male patients while only 3.5% of women were given thrombolytic therapy as compared to males 19.6%, $p = 0.003$. Acute coronary complications developed in 68%

of the men and 61.2% of the women, *p* = 0.998. Other patient characteristics are shown in Table 2.

Table 3 shows the types of complications in males and females coronary syndrome patients. Arrhythmias were confirmed in 33% of the men and 28.2% of the women; heart failure was found in 46.4% of the men and 52.9% of the women. Intraventricular thrombus was detected in 8% of the men and 2.3% of the women. Cardiogenic shock was evident in 14.2% of the males and 7.1% of the females, and sudden death occurred in 8% of the men and 4.7% of women. However, there was no significant statistical difference between the two groups regarding all in-hospital complications of acute coronary syndrome, *p* = 0.902.

DISCUSSION

Many studies have shown that females with acute coronary syndrome were significantly older than males. In this study, the women were younger than the men (55.3 ± 17.9 vs. 57.9 ± 11.8), *p* = 0.009 in contrast with previous studies.[11] Females in our study seemed to lose their hormonal protection earlier than their counterparts. This could be due to early menopause or hypogonadism.[12]

In the USA, it is estimated that 40 million people aged 18 years and above are smokers, with a small difference between men and women (18.8% in males vs. 14.8% females). Although smoking had declined from 20.9% in 2005 to 16.8% in 2014, cigarettes smoking was the leading cause of preventable diseases and death in the USA, accounting for 1 in every five deaths.[13,14]

The distribution of coronary risk factors was not in the current study: Smoking was significantly lower among women (*P* < 0.001). The difference in smoking can be explained by the conservatism of Sudan Society. Furthermore, many studies have shown similar results.[15]

A study published in Saudi Arabia[5] appears in agreement with this study and shows similar distribution of hypertension and diabetes mellitus between males and females. No gender inequality was found in our study regarding family history of myocardial infarction, a result which is different from a previous study in which family history of ischemic heart disease was found to be more prevalent in females.

The discrepancy in the distribution of coronary risk factors between genders could be the result of environmental factors. Published data have reported the significant differences between high and low altitude with regard to the distribution of coronary risk factors.[16] Sudan is a

Table 1: Baseline characteristics of acute coronary syndrome patients stratified by gender

Variable	Men (*n*=112) N (%)	Women (*n*=85) N (%)	*p*-value
Age, mean±SD	57.9±1.1	55.3±1.9	0.225
Medical history			
Hypertension	61 (54.5)	47 (55.2)	0.052
Diabetes mellitus	34 (30.3)	27 (31.7)	0.322
Family history of MI	21 (18.7)	19 (22.3)	0.438
Heart failure	62 (55.3)	43 (50.5)	0.047
Smoking	36 (32.1)	1 (1.2)	<0.001
Presenting complaint			
Chest pain	105 (93.7)	82 (96.4)	<0.021
Dyspnea	7 (6.3)	3 (3.5)	
Duration of chest pain (hour)			
<1.5	6 (5.4)	1 (1.2)	<0.001
1.5-12	23 (20.5)	11 (12.9)	
12-24	21 (18.7)	16 (18.8)	
>24	62 (55.3)	57 (67.1)	
Type of MI			
STEMI	64 (57.1)	30 (35.2)	0.009
NSTEMI	48 (42.9)	55 (64.8)	

SD: Standard deviation; STEMI: ST-segment elevation myocardial infarction; NSTEMI: Non-ST-segment elevation myocardial infarction; MI: Myocardial infarction

Table 2: Hospital course of acute coronary syndrome patients

Variable	Men (*n*=112) %	Women (*n*=85) %	*p*-value
Pulse			
Tachycardia	47.3	35.2	<0.001
Bradycardia	3.5	3.5	
Irregular	20.5	27	
Blood pressure			
High	19.6	27	<0.001
Low	31.1	17.8	
Specific treatment			
Thrombolysis	19.6	3.5	0.003
PCI	13.4	7	0.262
Low ejection fraction	58.7	65.1	0.246
In-hospital complications	68	61.2	0.998

PCI: Percutaneous coronary angioplasty

Table 3: Types of in-hospital complications of acute coronary syndrome patients

Complication	Men (*n*=112) %	Women (*n*=85) %	*p*-value
Arrhythmia	33	28.2	0.902
Heart failure	46.4	52.9	
Intra-ventricular thrombus	8	2.35	
Cardiogenic shock	14.2	7.1	
Death	8	4.7	

vast country that covers about 2% of the earth surface. Furthermore, Omdurman Teaching Hospital is one of the three Central Hospitals in Sudan serving a large area extending from the far west of Sudan to the middle of the country. Thus, our sample is representative of different environmental regions. Another explanation could be the differences in sample size of the various studies.

Differences in thrombotic and fibrinolytic activities, the severity of acute coronary syndrome, and the presence of coronary vessels collaterals could explain the high prevalence of NSTEMI among females.[17-19] In this study, NSTEMI was more common in women ($P = 0.009$), which is in agreement with previous studies.[7,15]

The under-treatment of women with acute coronary syndrome by invasive cardiac procedures is attributed to older age, co-morbidities, atypical presentation, or physician's apprehension of outcomes.[20,21] In this study, females were younger than males and had the same co-morbidities as the men, so no bias regarding PCI was observed ($p = 0.262$).

It is interesting to note that the majority of patients (67.1% of women vs. 55.3% of men) with a significant (statistical difference between males and females [$P < 0.001$]) arrived at the hospital more than 24 hours after the onset of symptoms. The reasons for this could have been the lack of awareness of acute coronary syndrome and difficulties in transportation.

The differences between males and females in receiving thrombolytic therapy (3.5% for women vs. 19.6% for men) may be because of the atypical presentation of myocardial infarction among females (fatigue, shortness of breath, and sleep disturbances). They are unable to link these symptoms to heart disease, so there is delay in seeking medical help and are more prone to misdiagnosis. Researchers concluded that more than half of women did not know that cardiovascular disease was the leading cause of death among females and only 13% felt that heart disease was the greater danger to their health.[22,23] In the patriarchal Sudanese Society, females are of a lower status than men.

The acute coronary complications (late arrhythmias, heart failure, cardiogenic shock, and death) were the same between males and females in this study ($p = 0.902$). This result remained robust even after controlling for smoking (crude odd ratio = 0.957: 0.543–1.683, and adjusted odd ratio = 1.15: 0.608–2.194) in agreement with previous findings.[6,11] Many other researchers revealed more complications among women.[18,24] The discrepancy in gender may be explained by higher coronary risk factors in the later studies.

Limitations of this study

- Since this was an observational study, we could not control for many confounders. Furthermore, we did not report ongoing medical therapy that could affect outcomes
- The sample size was relatively small
- This was a single center study so the results can only be generalized to the local region.

CONCLUSION

No risk factors of acute coronary risk factors with gender bias other than from smoking were found. However, atypical presentation and less thrombolytic therapy were observed among females. The observed differences did not affect the clinical outcomes in this Sudanese sample with many unwanted features such as high coronary risks and complications. This calls for larger multi-center studies to look for causes of gender bias in treatment, and estimate such complications as mortality and cardiogenic shock. Raising the awareness of the public about the importance of early introduction of therapy (aspirin at home), and early presentation to the hospital are of the utmost importance.

Conflicts of interest
There are no conflicts of interest.

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