

ORIGINAL ARTICLE

Acute vs Chronic Post-CABG Complications: Does Gender Matter? A Retrospective Cohort Study from the Jordan University Hospital Records

Noor Abu Hantash^{1*}, Shahed Abu Shirbi¹, Dyala Natheer¹, Jehad Yaseen¹, Elia Al-Makhamreh², Reham Rabah¹, Farhan Al-Maaiteh¹, Moaath Al-Smady³, Hanna Al-Makhamreh⁴

¹ School of Medicine, University of Jordan, Jordan, Amman

² School of Medicine, Jordan University of Science and Technology, Jordan, Amman

³ General surgery and cardiovascular surgery department, Jordan University Hospital, Jordan, Amman

⁴ Internal medicine department, cardiology department, Jordan University Hospital, Jordan, Amman

*Corresponding author:

abuhantashnoor91@gmail.com

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Abstract

Background: This study aimed to examine coronary artery bypass grafting (CABG) and its acute and chronic postoperative complications at Jordan University Hospital (JUH).

Methods: JUH's electronic health records (EHR) and surgery databases of 238 patients were reviewed from 1st January 2010 to 5th July 2024, regarding their relation to gender, techniques used in the surgery, and postoperative complications of CABG.

Results: The study cohort included 238 patients undergoing CABG, comprising 52 females (21.85%) and 186 males (78.15%). Postoperative complications were analyzed by gender. Among females, 17.31% (9/52) experienced complications, while 82.69% (43/52) had none. In males, 10.22% (19/186) exhibited complications, and 89.78% (167/186) were complication-free, yielding a total of 210 patients (210/238, 88.24%) without complications. Chi-square analysis revealed no significant association between gender and complication incidence ($\chi^2=1.35$, $p=0.246$). Complications were further stratified into acute and chronic categories. Females demonstrated the following: 9.62% (5/52) with acute complications (e.g., nosocomial infection), 3.85% (2/52) with concurrent acute and chronic complications (e.g., nosocomial infection and cataract), and 3.85% (2/52) with chronic complications (e.g., cataract). Among males, 3.76% (7/186) presented with acute complications, 0.54% (1/186) with both acute and chronic complications, and 5.91% (11/186) with chronic complications. A Chi-square test evaluating gender-based differences in acute versus chronic complication susceptibility showed no significant association ($\chi^2=6.84$, $p=0.077$; Monte Carlo $p=0.425$), with Monte Carlo simulation applied due to low expected cell frequencies. These findings suggest no statistically significant relationship between gender and the development of post-CABG complications, either in overall incidence or subtype (acute vs chronic).

Conclusion: Descriptive statistics showed that females had a higher incidence of complications than males overall and acutely, while males tend to develop their complications chronically. However, there is no significant association between gender and complications, either the total complications or the subclassified ones.

Keywords: CABG, coronary artery bypass, complications, gender, retrospective cohort.

INTRODUCTION

Coronary artery bypass grafting (CABG) is one of the most common surgical procedures used to treat coronary artery disease (CAD) and remains the most frequently performed cardiac surgery worldwide, now in its sixth decade of use [1]. CAD is associated with numerous risk factors endemic to Jordan, including age, gender, smoking, obesity, dyslipidemia, physical inactivity, hypertension, and diabetes mellitus [2].

In Jordan, ischemic heart disease affected an estimated 310,388 individuals in 2019, resulting in 11,798 deaths [3]. While percutaneous coronary intervention (PCI) is widely performed—with 2,426 procedures recorded across 12 Jordanian tertiary centers in 2013–2014 (77% for acute coronary syndromes) [4]—CABG is preferred for complex anatomies, heavy atherosclerotic burden, and long-term durability [1]. Globally, PCI volumes reach 450,000 annually in the U.S., compared to approximately 20,000 CABG procedures [1], though Jordan-specific CABG statistics remain limited. CABG techniques vary by conduit and surgical approach. The left internal mammary artery (LIMA) is the most commonly used graft, often supplemented by the great saphenous vein (GSV) [5,6]. The GSV can be harvested using the no-touch technique (with surrounding tissue) or the skeletonized methods [7,8], and may serve as a composite graft with LIMA [9]. Advances such as minimally invasive coronary surgery (MICS), robotic-assisted CABG, and hybrid revascularization have refined procedural options [1].

Despite these innovations, CABG remains high-risk, with many patients requiring emergency department visits or readmission within 30 days due to complications [10].

These complications—including acute (e.g., sternal wound infections, pneumonia, thromboembolism) and chronic (e.g., atrial fibrillation, pulmonary hypertension, renal injury)—vary based on patient health profiles and surgical history [10]. Notably, studies suggest gender disparities in outcomes: women face higher postoperative mortality and morbidity, attributed to older age at surgery, smaller coronary arteries, and greater comorbidity burden [11].

Recent advancements, such as robotic-assisted techniques and small thoracotomies, have improved outcomes, offering reduced invasiveness, shorter recovery times, and enhanced quality of life (QoL) [12]. This study aimed to analyze acute and chronic postoperative complications, their gender-based associations, and postoperative recovery in CABG patients at Jordan University Hospital (JUH), providing insights into surgical progress and QoL for Jordanian patients.

MATERIALS AND METHODS

Study Design

This retrospective cohort study investigated the association of sociodemographic characteristics, preoperative presentation, management approaches, and surgical techniques with postoperative outcomes and complications in patients undergoing coronary artery bypass grafting (CABG) at Jordan University Hospital (JUH).

Study Population and Sampling

Following ethical approval by JUH's Institutional Review Board (IRB Code: 375/2024/67), a comprehensive review of electronic records identified 391 patients who underwent elective CABG between 1 January 2010 and 5 July 2024. After excluding incomplete records (e.g., missing baseline

data, concurrent non-CABG cardiac procedures, loss to follow-up), the final cohort included 238 patients.

Data Collection

Data were systematically extracted from JUH's electronic health records (EHR) and surgical databases by six trained medical students. To minimize bias, each entry underwent dual verification by an independent student and a supervising specialist, ensuring adherence to cardiothoracic surgery documentation standards.

Inclusion Criteria

Eligible participants were adults (≥ 18 years) who underwent CABG during the study period.

Variables

Sociodemographic data included age, gender, BMI, and smoking status. Comorbidities encompassed diabetes, hypertension, hypercholesterolemia, dialysis dependence, COPD, carotid vascular disease, and aortic calcification. Cardiac history variables captured prior CABG, percutaneous coronary intervention, coronary artery disease, heart failure, arrhythmia, transient ischemic attack (TIA), cerebrovascular accident (CVA), and peripheral vascular disease. Preoperative metrics consisted of laboratory values (hematocrit, hemoglobin, white blood cells, red blood cells, platelets, creatinine), medications (aspirin, nitroglycerin, ACE inhibitors, antiplatelets, heparin, beta-blockers), and ejection fraction. Intraoperative variables included bypass time, number of diseased vessels, conduit type (arterial: internal mammary artery, radial artery; venous: saphenous vein), and surgical technique (on-pump, off-pump, minimally invasive; in situ vs. free grafting). Postoperative outcomes were categorized as

acute complications (occurring intraoperatively or during hospitalization: heart failure, renal failure [serum creatinine ≥ 1.5 mg/dl][13], type 5 myocardial infarction [new Q waves, CK > 700 U/L, or wall motion abnormalities][13], arrhythmia, infections, bleeding, reoperation, mortality) and chronic complications (documented ≥ 3 months post-CABG: graft patency issues, survival rates).

Statistical Analysis

Analyses were performed using Python (v3.10) with pandas, scipy, and statsmodels. Descriptive statistics summarized frequencies and percentages. Associations between categorical variables were assessed using Pearson's Chi-square test; for small expected cell counts (< 5), Monte Carlo simulation (10,000 replicates) generated empirical p-values. Group differences in proportions were evaluated via two-sample Z-test. Statistical significance was defined as ($p < 0.05$).

Ethical Considerations

The study complied with JUH IRB guidelines (Code: 375/2024/67). Data were anonymized, and confidentiality maintained. Large language models (ChatGPT-4, DeepSeek) assisted only in proofreading the manuscript; data analysis, interpretation, and drafting were conducted by researchers.

RESULTS

The study cohort comprised 238 patients undergoing CABG at Jordan University Hospital, with 186 males (78.2%) and 52 females (21.8%). The mean age was 58.1 years (SD = 8.92), with 40.3% aged 60–69 years. The mean BMI was 28.3 kg/m² (SD = 5.7). Most patients were nonsmokers (47.9%) and had comorbidities (92.0%), predominantly hypertension (46.1%), diabetes mellitus (37.9%), and dyslipidemia (14.6%).

Preoperative laboratory profiles revealed that 80.24% of patients had hematocrit <36%, while 22.27% exhibited hemoglobin <12 g/dL. White blood cell ($4\text{--}11 \times 10^9/\text{L}$) and red blood cell ($3.5\text{--}5.5 \times 10^{12}/\text{L}$) counts were within normal ranges for 81.93% and 81.09% of patients, respectively. Platelet counts ($150\text{--}450 \times 10^9/\text{L}$) were normal in 87.82%.

Surgically, 85.7% underwent on-pump CABG, with left internal mammary artery (LIMA) grafts utilized in 97.4% and great saphenous vein (GSV) conduits in 76.1% (Table 1).

Postoperative Complications

Overall, 28 patients (11.7%) experienced complications. Females had a higher complication rate (17.31%, 9/52) compared to males (10.22%, 19/186). Among females, 5 cases (9.62%) involved acute complications (e.g., nosocomial infections), 2 (3.85%) had combined acute/chronic

complications, and 2 (3.85%) had chronic complications. Males predominantly exhibited chronic complications (5.91%, 11/186), including heart failure and chronic coronary occlusion, with fewer acute events (3.76%, 7/186) (Table 2).

Acute complications included mortality at discharge (21.4%), nosocomial infections (17.9%), and myocardial infarction (10.1%). Chronic complications featured coronary chronic total occlusion (21.4%) and heart failure (14.3%) (Table 3).

Statistical Analysis

No significant association emerged between gender and complication incidence ($\chi^2 = 1.35$, $p = 0.246$) or complication type (acute vs chronic: $\chi^2 = 6.84$, $p = 0.077$; Monte Carlo $p = 0.425$). A two-proportion Z-test confirmed no gender-based disparity in complication rates ($Z = 1.40$, $p = 0.161$), though females exhibited a nonsignificant trend toward higher complications (Figure 1).

Table 1: descriptive patient data: sociodemographic, medical history, preoperative data, and operative information.

Variable	count	Percentage%
Gender		
Males	186	78.2
Females	52	21.8
BMI (kg/m ²)		
<18.5	1	0.4
18.5-24.9	30	12.6
25-29.9	159	66.8
30-39.9	45	18.9
>=40	3	1.3
Smoking status		
Smokers	75	31.5
Non-smokers	161	67.6
Comorbidities		
No	19	8
Yes	219	92
History of cardiac intervention		
Yes	162	68.1
No	76	31.9

Variable	count	Percentage%
EF %		
<50	79	33.19
50-70	159	66.81
CPB type		
On pump	204	85.7
OPCAB	34	14.3
Pump time (min)		
1-59	91	44.6
60-119	41	20.1
120-179	8	3.9
Arterial conduits		
LIMA	232	97.4
LIMA and RA	4	1.7
RIMA	2	0.8
Venous conduits		
GSV	181	76.1

BMI: body mass index, HTC: hematocrit, HB: hemoglobin, WBCs: white blood cells, RBCs: red blood cells, Plts: platelets, EF: ejection fraction, CPB: cardiopulmonary bypass, OPCAB: off-pump coronary artery bypass, LIMA: left internal mammary artery, RA: radial artery, RIMA: right internal mammary artery, GSV: great saphenous vein. Hypertension, diabetes mellitus, dyslipidemia, and heart failure percentages are out of 219(the comorbid patients). Pump time percentages are out of 204(on pump cases).

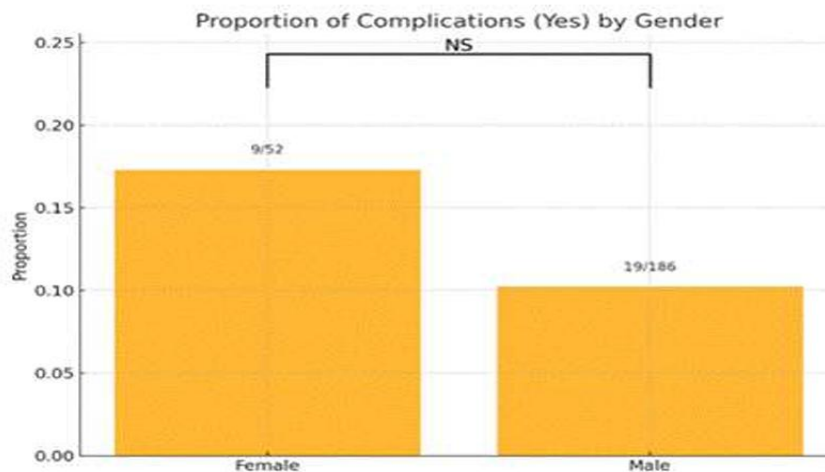
Table 2: statistical association of gender with acute and chronic complications

Gender	Complications, n (%)				Chi-Square (p-value)
	Yes			No	
Female	9 (17.31)			43 (82.69)	1.35 (p = 0.246)
Male	19 (10.22)			167 (89.78)	
	Acute only	Acute and chronic	Chronic only	No complications	
Female	5 (9.62)	2 (3.85)	2 (3.85)	43 (82.69)	6.84 (p = 0.077, Monte Carlo p = 0.425)
Male	7 (3.76)	1 (0.54)	11 (5.91)	167 (89.78)	

Table 3: Percentages of different post-operative acute and chronic complications stratified by gender

Complication	Female (N = 9)	Male (N = 19)	All (N = 28)
<u>Acute</u>			
Acute Kidney Injury	0 (0.0%)	2 (10.6%)	2 (7.2%)
Death at Discharge	3 (33.3%)	3 (15.8%)	6 (21.4%)
Drug-Induced Liver Injury	1 (11.1%)	0 (0.0%)	1 (3.6%)
Ischemic Hepatitis	1 (11.1%)	0 (0.0%)	1 (3.6%)
Myocardial Infarction (MI)	3 (33.3%)	0 (0.0%)	3 (10.1%)
Pleural Effusion	1 (11.1%)	0 (0.0%)	1 (3.6%)
Septic Shock	1 (11.1%)	0 (0.0%)	1 (3.6%)
Bleeding	0 (0.0%)	1 (5.3%)	1 (3.6%)
Hypocalcemia	0 (0.0%)	1 (5.3%)	1 (3.6%)
Nosocomial Infection	3 (33.3%)	2 (10.6%)	5 (17.9%)
Arrhythmia	0 (0.0%)	2 (10.5%)	2 (7.1%)
Pericardial Effusion	0 (0.0%)	1 (5.3%)	1 (3.6%)
<u>Chronic</u>			
Liver Failure	0 (0.0%)	1 (5.3%)	1 (3.6%)
Heart Failure	0 (0.0%)	4 (21.1%)	4 (14.3%)
Cataract	1 (11.1%)	0 (0.0%)	1 (3.6%)
Chronic Total Occlusion of Coronary Arteries	2 (22.2%)	4 (21.1%)	6 (21.4%)
Myocardial Infarction (after more than 3 months)	0 (0.0%)	2 (10.5%)	2 (7.1%)
Chronic Ischemic Heart Diseases other than MI	1 (11.1%)	2 (10.5%)	3 (10.7%)

Note: One patient might have had > 1 complication. There are 2 unknown complications among the acute complications in males. Percentages are reported out of the total number of complications for each group (Male, Female, All).

**Figure1: proportion of complications by gender**

DISCUSSION

This study illustrated the gender-related differences in postoperative complications associated with CABG surgery. Previous studies suggested that females tend to have a higher risk for postoperative complications due to anatomical and physiological differences between genders [14–16]. In a study conducted by Dixon et al., using an insight database, they discovered that women undergoing coronary artery bypass grafting (CABG) in the United Kingdom faced an elevated likelihood of experiencing postoperative complications [14]. Furthermore, females in the UK exhibited an increased risk of short-term mortality after cardiac surgery compared to males [14]. Similarly, Matyal et al. conducted retrospective analyses of institutional data housed in the Society of Thoracic Surgeons (STS) database for patients undergoing CABG between 2002 and 2020 in the US and observed that women undergoing CABG surgery exhibit higher rates of postoperative prolonged ventilator dependence and cardiac-related readmission and mortality compared to men [15]. According to Nufkkala et al.'s cohort study in Finland, the adverse outcomes following CABG seem to vary between men and women in terms of both quantity and quality [16]. Women undergoing CABG experience greater long-term risks of cardiac death and various other diseases compared to men [16]. Female patients undergoing CABG face an elevated susceptibility to postoperative diseases, heightening the risk of mortality [16]. Following CABG, women exhibit a notably increased relative risk of long-term mortality compared to men [16].

However, our study showed no statistically significant correlation between gender and total post-CABG complications

(p -value = 0.246). Nevertheless, it is worth mentioning that the descriptive statistics showed that females had a higher incidence of complications than males (17.31% vs. 10.22%), supporting the findings of the aforementioned literature [11,17–19].

Clinical Implications

Interpretation of our results showed that 17.31% of females had complications following their surgery, while only 10.22% of males did. In females, 9.62% faced acute complications, 3.85% presented with chronic complications, and 3.85% presented with both acute and chronic complications. For males, 3.76% reported acute complications, 5.91% reported chronic complications, with another 0.54% reporting both acute and chronic complications. Even though there is an apparent difference in the statistics, the lack of statistical significance ($p = 0.077$ for acute vs. chronic complications) suggests that gender itself cannot be considered an independent risk factor for increased complications. Other than the difference in overall complications, data also suggest that acute complications in females (9.62%) seem to be more common than chronic complications (3.85%), whereas the opposite is true in males (3.76% and 5.91%, respectively). These differences can be attributed to anatomical variations seen between the two genders, such as the smaller size of coronary arteries in females or the fact that female patients usually present at an older age [20,21].

Even though no significant statistical differences were noted, it is important not to overlook the variations in the results seen between males and females. Looking into methods to reduce the risk of acute complications in females, such as including a more individualized perioperative approach and using alternative methods to improve the

patency of the grafts while considering anatomical differences, is critical. There is no “one size fits all” when it comes to surgical methods used on each patient.

The most reported acute or chronic complications were intrinsic to the heart: type 5 MI and death in acute complications, and heart failure in chronic complications. This raises inquiries about the superiority of operative techniques, such as the invasiveness of on-pump procedures, the sufficiency of harvested vessels (LIMA and GSV), the impact of comorbidities, delays in surgery, and preoperative care on survival. It could also be attributed to postoperative commitment to intensive care [22,23]. These inquiries need real-life answers through prospective follow-up for patients.

Nosocomial infections and sepsis constituted 21.5% of acute complications (fever, septic shock, and nosocomial infection). Considering these are preventable complications, this percentage is high. This emphasizes the importance of using minimally invasive techniques, negative pressure wound therapy [24], avoiding bilateral internal mammary artery (BIMA) harvesting, and adhering to prophylactic antibiotic protocols [26].

Limitations and Future Directions

Certain limitations should be noted. First, as a retrospective study using electronic health records, it is prone to selection bias due to incomplete data for some patients. The final sample may not fully represent the entire population of CABG patients. Second, the cohort size ($n = 238$) may lack sufficient power to detect subtle gender-based disparities. A multicenter study with a larger sample size might reveal statistically significant differences. Third, complications occurring between admissions (e.g., outpatient complications or events treated at

other facilities) could not be captured, potentially underestimating the true incidence of chronic complications. Finally, unmeasured confounders, such as socioeconomic status or postoperative rehabilitation adherence, were not analyzed.

CONCLUSION

Even though our study showed a lack of significant statistical difference between gender and postoperative complications, it is important not to completely rule out gender as a possible risk factor, considering the study's limitations. Other factors must also be considered when evaluating gender as a potential risk factor, given the intricate interplay of variables mediating CABG outcomes. Larger-scale prospective studies with robust follow-up mechanisms are necessary to validate these trends and clarify the role of gender in post-CABG complications.

Disclosure

The authors of this research, focused on coronary artery bypass grafting (CABG) through reviewing medical records at Jordan University Hospital (JUH), have received no external funding. The study complies with ethical standards and has been approved by the relevant ethics committee at the University of Jordan to ensure confidentiality and objectivity throughout the research process. AI was used only for proofreading, providing it with self-written original research sections.

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Supplementary

Questionnaire:

<https://drive.google.com/file/d/10qE0rqGiCYIRKmxDtyisZyYkO8KcCSDA/view?usp=drivesdk>

involvement

Data sharing statement: from hospital records upon request, raw data

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المضاعفات الحادة مقابل المزمنة بعد جراحة مجازة الشريان التاجي: هل الجنس مهم؟ دراسة أترابية بأثر رجعي من سجلات مستشفى الجامعة الأردنية

نور أبو هنطش¹، شهد أبو شربي¹، ديانا نذير¹، جهاد ياسين²، إيليا المخامرة²، رهام رباح¹، فرحان المعاينة¹، معاذ الصمادي³، حنا المخامرة⁴

الملخص

الخلفية: تهدف هذه الدراسة إلى تحليل مضاعفات ما بعد جراحة مجازة الشريان التاجي (CABG) الحادة والمزمنة في مستشفى الجامعة الأردنية (JUH) **المنهجية:** تمت مراجعة السجلات الصحية الإلكترونية (EHR) وقواعد بيانات الجراحة لـ 238 مريضاً خضعوا للجراحة بين 1 يناير 2010 و 5 يوليو 2024، مع التركيز على العلاقة بين الجنس والتقنيات الجراحية المستخدمة والمضاعفات اللاحقة. **النتائج:** شملت العينة 238 مريضاً (52 أنثى، 21.85%؛ 186 ذكراً، 78.15%). لوحظت مضاعفات لدى 17.31% من الإناث (52/9) مقابل 10.22% من الذكور (186/19). أظهر تحليل مربع كاي عدم وجود ارتباط ذي دلالة إحصائية بين الجنس وحدث المضاعفات ($\chi^2=1.35$)، قيمة ($p=0.246$) عند تصنيف المضاعفات إلى حادة ومزمنة، كانت النتائج كالتالي: الإناث (5/52) 9.62% : مضاعفات حادة (مثل العدوى المكتسبة من المستشفى)، 3.85% (52/2) مضاعفات حادة ومزمنة معاً (مثل العدوى والساد)، و3.85% (52/2) مضاعفات مزمنة. الذكور 3.76% : (7/186) مضاعفات حادة، 0.54% (186/1) مضاعفات مشتركة، و5.91% (186/11) مزمنة. أظهر اختبار مربع كاي عدم وجود فرق ذي دلالة إحصائية في توزيع المضاعفات حسب النوع ($\chi^2=6.84$)، قيمة ($p=0.077$)؛ مع تطبيق محاكاة مونت كارلو بسبب صغر حجم العينة. **الاستنتاجات:** على الرغم من أن الإناث أظهرن معدلاً أعلى من المضاعفات الحادة مقارنة بالذكور (الذين تميل مضاعفاتهم إلى أن تكون مزمنة)، إلا أنه لا يوجد ارتباط إحصائي بين الجنس ومضاعفات ما بعد الجراحة أو أنواعها.

¹كلية الطب، الجامعة الأردنية، عمان، الأردن
²كلية الطب، الجامعة الأردنية للعلوم والتكنولوجيا، عمان، الأردن
³قسم الجراحة العامة وجراحة القلب والأوعية الدموية، مستشفى الجامعة الأردنية، عمان، الأردن
⁴قسم الطب الباطني وقسم أمراض القلب، مستشفى الجامعة الأردنية، عمان، الأردن

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