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Original Research Article

Impact of gender on outcome of adult cardiac surgery

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ABSTRACT

Background: Objective of the study was to identify differences in preoperative, intraoperative, and postoperative parameters between female and male cardiac surgical patients.
Methods: This is a prospective observational analysis of adult cardiac surgical patients presenting for cardiac surgery at Queen Alia Heart Institute in the period between September 2023 and January 2024. Patients' demographics, type of surgery (cardiac pathology), comorbidities, and perioperative, parameters were recorded and analysed. Males and females were compared according to their age at time of surgery, operative time, intensive care unit (ICU) stay, hospitalisation time and mortality. Male and female patients undergoing coronary surgery were compared.
Results: Data from 166 adult cardiac surgical patients was analysed. They constituted 135 males and 31 females. Male to female ratio was 4.4:1. When considering all types of cardiac surgery, female patients had longer duration of hospitalisation (13.1 days) than males (11.5 days). Moreover, mortality was higher in the female subpopulation (12.9%) than the male subpopulation (8.1%). Only 14% of coronary artery bypass grafting (CABG) patients were females and they had higher in-hospital mortality (20%) versus 7.4% in males.
Conclusions: Female patients present for CABG less commonly than males and at more advanced age. Mortality rates are higher in females and hospitalisation time is longer.

Keywords: Adult, CABG, Cardiac, Female, Gender, Mortality

INTRODUCTION

Cardiovascular disease is leading cause of morbidity and mortality globally. The most common cardiovascular disease is coronary heart disease (ischaemic heart disease) with a global prevalence of around 200 million in 2019.[1] There is increasing evidence that gender-related differences in cardiovascular diseases (CVDs) exist. This is due to differences in cardiac structure and function, sex hormones, and socio-psychological characters between males and females, thus leading to disproportions in the predisposition to and development of CVDs, age at presentation, severity, outcomes of medical and surgical therapy.[2] Oestrogen has long been hypothesised to limit atherosclerotic progression and delay the presentation of CVDs in females. Efforts to clarify the underlying mechanisms of the gender-related differences in CVDs over the last decades have proposed the effects of oestrogen hormone in modulating cardioprotective and immunoregulatory effects as factors for the observed dissimilarities in the incidence of CVDs among premenopausal and post-menopausal women and men.[3] For patients with coronary artery disease, gender influences pathogenesis, pathophysiology, and age at presentation, severity, treatment decisions, postoperative complications, surgical outcomes, and survival. The

overall prevalence of coronary artery disease is lower in women, and they tend to develop heart problems at older ages. CVD develop around 10 years later in females than in males and is the main cause of death in the female subpopulation over 65 years.[4] Around 370,000 coronary surgeries are performed in the United States each year, and females comprise 20-30% of the patients.[5] The female gender has been related to worst outcome following myocardial infarction in some studies, while other studies found no influence of gender on outcome.[6] Coronary artery bypass grafting surgery (CABG) is the optimal therapy for acute coronary syndrome when intervention is needed and percutaneous coronary intervention (PCI) is infeasible. Many studies have shown increased risk of postoperative complications, longer mechanical ventilation times, and higher incidence of hospital readmission after discharge and higher operative mortality in female patients undergoing CABG.[7-9] This was attributed to the smaller size of coronaries, smaller body surface area (BSA) and more advanced age at presentation for surgery.[10]

METHODS

This is a prospective observational analysis of adult cardiac surgical patients presenting for cardiac surgery at Queen Alia Heart Institute in the period between September 2023 and January 2024. Patients' demographics, type of surgery, comorbidities, and perioperative, parameters were recorded and analysed. Males and females were compared according to their age at time of presentation for cardiac surgery, cardiopulmonary bypass duration, aortic cross clamp duration, length of ICU stay, length of hospitalisation time and mortality. Additionally, gender comparison was made in patients undergoing coronary surgery. Statistical analysis performed using Microsoft excel. Ethical committee approval obtained. The sample size represents cardiac surgical patients presented to our centre during the period of this study. Inclusion criteria included: adult cardiac surgical patients (age >18 years); coronary, valve or aortic surgery; and complete peri-operative data available. The exclusion criteria included: paediatric cardiac surgical patients; minor cardiac procedures (such as pacemaker lead insertion, and drainage of pericardial effusion; and patients with incomplete or missing peri-operative data.

RESULTS

A total 166 adult patients presenting for cardiac surgery were included in this study. Average age of patients was 56.9 years (ranged from 19 to 78). Male patients were 135 (81.3%) and female patients were 31 (18.7%). Male to female ratio was 4.4:1. On average 65.7% of patients were hypertensive, 51.8% diabetic and 84.9% suffered from ischaemic heart disease. Details of patients' demographic and clinical data with gender comparison are found in Table 1. When considering all types of cardiac surgery, female patients had longer duration of hospitalisation (13.1 days) than males (11.5 days). Moreover, mortality was higher in the female subpopulation (12.9%) than the male subpopulation (8.1%).

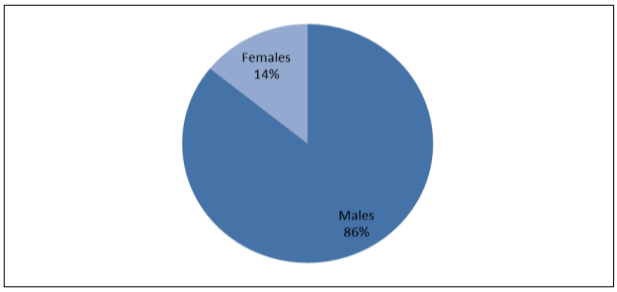

Figure 1: CABG surgery distribution in both genders.

CABG was the most common procedure in both genders, as 89.6% of males had CABG (solo or combined with other cardiac procedure) and 64.5% of females had coronary revascularisation surgery. From 141 CABG procedures the vast majority of patients were males (Figure 1).

Female patients presenting for CABG were on average 3 years older than males at time of presentation for surgery. Duration of cardiopulmonary bypass was longer in males than females undergoing CABG (111.1 minutes and 99.7 minutes, respectively). Similarly, the aortic cross clamp duration was also longer in males undergoing CABG (60.4 minutes and 58.7 minutes, respectively). Intensive care unit length of stay was around one day longer in male patients after CABG (4.7 days) than females (3.8 days). However, the mortality rate after CABG was significantly higher in female patients (20%) than males (7.4%) (Table 2).

Table 1: Comparison between male and female adult cardiac surgical patients.

All types of cardiac surgeries	Males	Females	Total
Number of patients (%)	135 (81.3)	31 (18.7)	166
Average age (years)	57.2	55.4	56.9
Hypertensive (%)	85 (63)	24 (77.4)	109 (65.7)
Diabetic (%)	72 (53.4)	14 (45.2)	86 (51.8)
Average BMI (kg/m²)	28.65	28.5	28.56
Ischaemic heart disease (%)	121 (89.6)	20 (64.5)	141 (84.9)
Heart valve disease (%)	14 (10.4)	8 (25.8)	22 (13.3)
Elective surgery (%)	126 (93.4)	28 (90.3)	154

Continued.

All types of cardiac surgeries	Males	Females	Total
Urgent surgery (%)	7 (5.2)	1 (3.2)	8
Emergency surgery (%)	2 (1.5)	2 (6.5)	4
Coronary artery bypass grafting (%)	121 (89.6)	20	141
Aortic valve replacement (%)	7 (5.2)	1 (3.2)	8
Mitral valve replacement (%)	7 (5.2)	5 (16.1)	12
Tricuspid valve replacement (%)	0 (0)	2 (6.4)	2
Aortic surgery (%)	4 (3)	1 (3.2)	5
Repair of atrial septal defect (%)	0 (0)	1 (3.2)	1
Repair of ventricular septal defect (%)	0 (0)	1 (3.2)	1
Combined surgery (CABG+valve (s)) (%)	9 (6.7)	0 (0)	9
Average cardiopulmonary bypass duration (minutes)	111.1	99.7	109
Average aortic cross clamp duration (minutes)	65.7	61.5	64.9
Postoperative mechanical ventilation time (hours)	21.7	20.6	21.6
Intensive care unit stay (days)	4.7	4.04	4.6
Hospitalisation time (days)	11.5	13.1	11.64
In-hospital mortality (%)	11 (8.1)	4 (12.9)	15

Table 2: Comparison between male and female patients presented for CABG.

CABG	Males	Females	Total CABG patients
Number of patients (%)	121 (85.8)	20 (14.2)	141
Average age at presentation for CABG (years)	56.7	60.1	57.9
Elective CABG (%)	113 (93.4)	18 (90)	131 (92.9)
Urgent CABG (%)	6 (5)	1 (5)	7 (5)
Emergency CABG (%)	2 (1.7)	1 (5)	3 (2.1)
Hypertensive (%)	83 (68.6)	19 (95)	102 (72.3)
Diabetic (%)	66 (54.5)	12 (60)	78 (55.3)
Obesity (BMI>30 (kg/m²)	44 (36.4)	6 (30)	50 (35.5)
Average BMI (kg/m²)	30.04	27.8	28.73
History of smoking (%)	95 (78.5)	6 (30)	101 (71.6)
Duration of cardiopulmonary bypass (minutes)	107.4	105.5	106.6
Duration of aortic cross clamp (minutes)	60.4	58.7	59.1
Postoperative mechanical ventilation time (hours)	14.7	14.8	14.7
Intensive care unit stay (days)	4.7	3.875	4.5
Hospitalisation time (days)	11.70	11.74	11.71
In-hospital mortality (%)	9 (7.4)	4 (20)	13 (9.2)

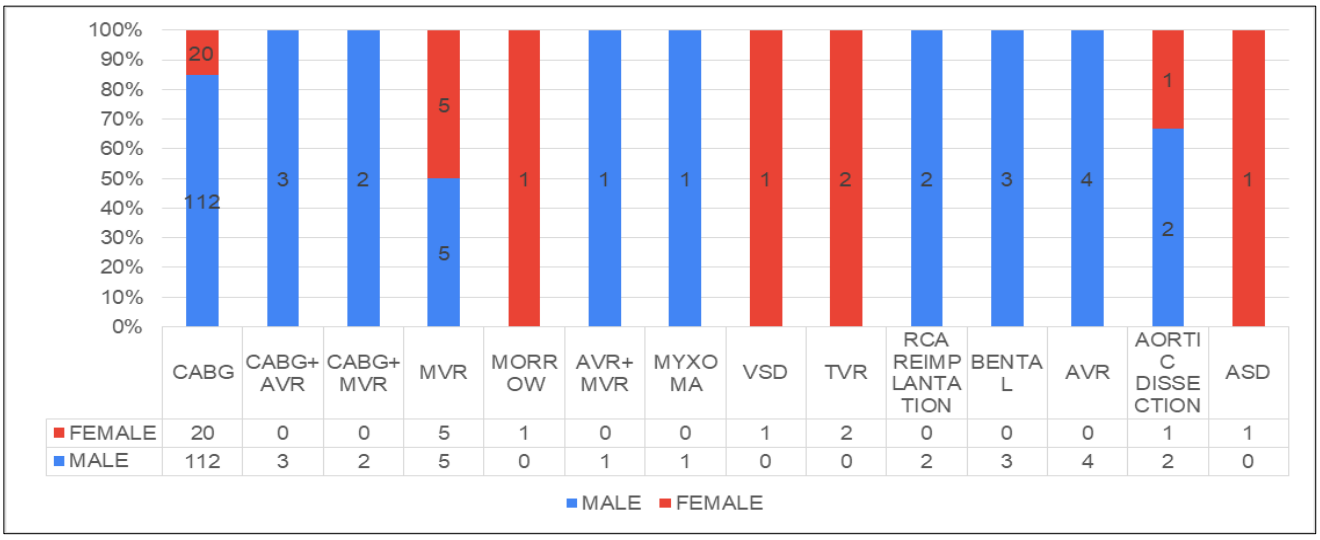

Figure 2: Distribution of types of cardiac surgery according to gender.

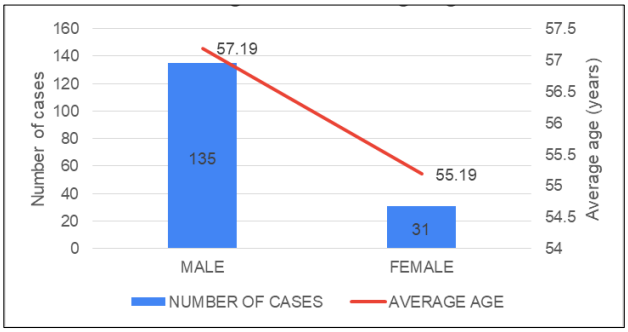

Figure 3: Age distribution of patients undergoing cardiac surgeries according to gender.

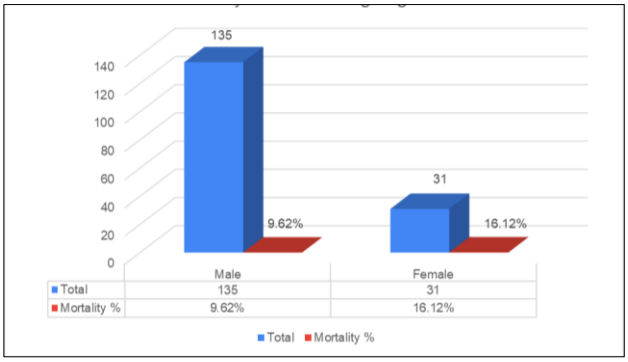

Figure 4: Mortality rate according to gender.

DISCUSSION

Gender-related disparities in the incidence of cardiovascular disease (CVD) have been observed and investigated. These gender differences exist in various CVDs, including coronary arteries diseases, heart valves diseases and aortic diseases.[11] Understanding these differences is of paramount value for the prevention, diagnosis and possible treatments of CVDs.

When considering all types of cardiac surgery, we found that female patients were less likely to have coronary surgery, but more likely to have mitral valve surgery; as 16.1% of the females had mitral valve procedure, whereas only 5.2% of the males needed mitral valve intervention. On average, female patients presented at a younger age for surgery when all types of heart surgery were considered; however, when coronary surgeries were considered, female patients were around three to four years older than males with coronary disease at time of presentation for CABG. There was no significant difference in comorbidities, body mass index, time to extubation after surgery and ICU length of stay, albeit time of hospitalisation was 1.6 days longer and mortality was 30% higher in the female subpopulation (Table 1).

The incidence of coronary artery disease (CAD) is lower in females than males of similar age. On the other hand, CAD in females has been reported to be more severe, more difficult to treat and caries a worse prognosis especially after CABG.[12] Our study included 166 cardiac surgeries that included 141 CABG procedures, with male preponderance of 85.6% and female minority of 14.2%. This means that coronary surgeries were sixfold performed on males in our centre in the period of our study. In the United States 20 to 30% of CABG procedures were performed on females.[13] The effect of gender on the outcome of CABG procedures has also been addressed by many studies. Guru et al. reported higher rates of hospital readmission and congestive heart failure after CABG surgery in females than males.[14] Guadino et al also reported that females have worse outcomes than males in the first 5 years after CABG and that the difference is not related to the surgical technique.[15] Higher mortality rates after CABG in females were also reported by Mannacio et al and Shi et al and many other authors.[16,17] In our analysis the mortality rate after CABG was approximately three times higher in females (20%) than males (7.4%). The durations of cardiopulmonary bypass and aortic cross clamp during CABG procedures were very similar in males and females (with only 2-3 minutes difference) which indicate that surgery itself was not more difficult (Table 2). Vaccarino et al. attributed the higher mortality to a more difficult recovery compared with males, which is not explained by the severity of CAD, pre-operative health, or other patient related factors.[18] In our study, the average time of mechanical ventilation post-CABG, the length of ICU stays and hospitalisation time did not show significant difference when gender was considered (Table 2).

Limitations

This study has several limitations: the observational nature of the study, the limited number of patients and being a single centre study.

CONCLUSION

Female patients presented less often for coronary surgery than males. Female patients presented for coronary surgery were at more advanced age and had higher mortality rates. Hospitalisation time was longer in females after cardiac surgery.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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