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FACTORS INFLUENCING LENGTH OF STAY IN THE INTENSIVE CARE UNIT AFTER CORONARY ARTERY BYPASS GRAFT IN DUHOK CITY – KURDISTAN REGION

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ABSTRACT

Background: Long stays in the Intensive Care Unit (ICU) following coronary artery bypass graft (CABG) surgery are associated with higher hospital mortality, poor long-term prognosis, prolonged hospital admissions, and consequently, excessive cost and resource use. This study aimed to identify the individual and perioperative risk factors influencing ICU length of stay after coronary artery bypass graft surgery at Azadi Heart Center in Duhok city.

Patients and Methods: This comparative cross-sectional study reviewed the medical records of 230 patients who underwent CABG surgery from 1st January 2019 to 31st December 2020. The patients were divided into two groups based on their length of stay in the ICU. The usual stay group (ICU length of stay < 72 h), and the prolonged stay group (ICU length of stay ≥ 72 h).

Results: Among the 230 patients studied, 53 (23.04%) patients had an ICU length of stay ≥ 72 hours and 177 (76.96%) patients had an ICU length of stay < 72 hours and the mean duration of ICU stay was 2.45 days, ranging from 1 to 13 days. This study found that the factors increasing the ICU length of stay after CABG were; preoperative myocardial infarction (MI), elevated preoperative WBC counts, prolonged cardiopulmonary bypass (CPB) time, prolonged intubation, reintubation, reoperation, readmission, arrhythmia, receiving inotropic agents in the ICU, cardiac, pulmonary, and wound complications, and a higher postoperative troponin level.

Conclusion: This study showed pre-, intra-, and post-operative clinical and surgical risk factors affect prolonged ICU stays.

KEYWORDS: Coronary artery bypass graft, Cardiac intensive care unit, Length of stay, Risk factors, Postoperative complications.

INTRODUCTION

Coronary artery disease (CAD), also known as coronary heart disease (CHD) or ischemic heart disease (IHD), is one of the leading causes of morbidity, death, and disability in both the developed and developing worlds. According to the most current worldwide study, CAD is responsible for 15.5% of total global deaths and 43% of CVD mortality (Ralapanawa Sivakanesan, 2021).

Management of CAD has greatly improved in recent decades, resulting in a better quality of life and longer survival. Coronary artery bypass graft surgery (CABG), also known as heart bypass surgery, is a common surgical procedure of coronary revascularization. This is generally recommended in patients who fail to control it with medical treatments or lifestyle changes to restore normal blood flow to obstructed vessels and re-establish perfusion to the myocardium, representing annual volumes of more than one million operations worldwide. Frequently, within two basic techniques, the traditional manner, known as on-pump CABG (ONCAB), or the newer way, known as off-pump CABG (OFF CAB) (OFCAB) (Jia et al., 2020, Wang et al., 2021).

Despite the benefits of CABG in controlling the signs and symptoms of CAD, CABG surgery is still a high-risk operation, with various complications occurring during and after the procedure, particularly in older and high-risk patients. As a result, all patients must be transported from the operating room (OR) to the cardiac surgery cardiac intensive care units (CICUs) following surgery in order to detect and manage complications. CICUs are high-tech special treatment units designed for close monitoring, prompt intervention, follow-up, and care of patients undergoing cardiac surgery for

periods ranging from one to several days (Bigand, 2018, Mackie Saravanan, 2021).

There is no universally accepted definition for a prolonged CICU stay post cardiac surgery, and there is currently an ongoing debate on the definition, which range from >24 hours to >14 days. According to National Cardiac Benchmarking Collaborative statistics, the majority (75%) of patients receiving CABG surgery in various cardiac surgical centers require roughly 24 to 36 hours in CICU. The length of stay (LOS) of a patient in the CICU following CABG surgery is determined by the patient's pre-operative characteristics, the quality of care provided in the operating room and ICU, complications, and events during and after surgery, as well as hospital regulations and policies governing CICU discharge (Curtis et al., 2012, Diab et al., 2017).

Due to advancements in the field of cardiac surgery throughout the years. Despite a higher-risk patient profile, fatality rates owing to CABG surgery have decreased dramatically in modern practice over the last decade across the world; yet, death still occurs. According to recent research, the current CABG fatality rate is modest, ranging from 1-3%, whereas the survival rate is low in patients who require a prolonged ICU stay (Chan et al., 2021). In addition to the advances in cardiac surgical techniques, with the ageing population, cardiac surgery is now being undertaken in elderly, more complicated cases with an increased number of comorbidities which can raise the incidence rate of postoperative complications. As a result, more patients require a prolonged stay in the ICU (Dominici et al., 2020). This study attempted to identify risk factors that impact prolonged ICU stay following CABG surgery.

PATIENTS AND METHODS

Study design

In this retrospective cross-sectional study, the patients who underwent CABG were included. The medical records of the patients who received CABG at a tertiary heart center were reviewed for the eligibility criteria. The cases were included from Azadi Heart Center in Duhok city in the period between September 1, 2021, to December 1, 2021. This study included 230 patients after excluding no eligible patients from the analysis. The patients were divided into two groups based on the ICU length of stay. patients who stayed in the ICU for <72 hours were considered the usual stay group (n=177), and those who stayed ≥ 72 hours were determined as the long stay group (n=53) in this study (Oliveira et al., 2013, Kao et al., 2022). Data were compared between both groups regarding different factors that influenced a prolonged ICU stay.

Population and setting

The population of this study was the patients who underwent CABG in Azadi Heart Center. The patients had different ages, genders, medical information, and other socio-demographic aspects within Duhok province. The Azadi Heart Center is the only tertiary specialized center for diagnostic and therapeutic services for cardiac patients in Duhok province. Therefore, we expect that we have included as many as possible patients who met the eligibility criteria in this region. Only a few numbers of patients attend the private sector for therapeutic services in this region. Hence, we do not expect that these few numbers affect the overall results of the study. The researchers had no access to the medical records of the private sector due to administrative difficulties.

Inclusion and exclusion criteria

The inclusion criteria were comprised of age ≥ 18 years and all patients who received CABG surgery from 1st January 2019 to 31st December 2020. Patients who underwent CABG that was combined with a heart valve replacement or repair or other surgical procedures and/or who died after surgery were excluded. As well as, patients with more than 20% missing information in their medical records were not included in this study. Finally, 230 patients were included n this study (177 were in usual stay groups and 53 in long stay groups).

Data collection methods

The medical records of the patients who underwent CABG surgery were reviewed by a researcher. The records were checked by an assistant accordingly to avoid a possible mistake. The information was entered in a pre-designed questionnaire. The information obtained from the patient's medical records was used to fill out a questionnaire. This questionnaire consists of three sections: demographic data, risk factors (before, during, and after surgery), and length of ICU stay.

Statistical methods

The general characteristics of patients with usual and a long stay at ICU were presented in mean (SD) or median (IQR) for continuous and number (%) for nominal variables. The

comparisons of general, pre-operative, post-operative, and complications between usual and long stay were examined in an independent t-test or Pearson chi-squared tests. The significant level of difference was determined by a p-value<0.05. The statistical calculations were performed by JMP pro14.3.0.

Ethical committee statement

Ethical committee approval is granted from the Duhok Directorate General of Health on 24-October-2021 with a reference number: 24102021-10-7. Email: scientific.research@duhokhealth.org

RESULTS

This retrospective comparative cross-sectional study included 230 patients who underwent CABG. Out of 230 patients who had undergone CABG, only 53 patients (23.04%) stayed ≥ 72 hours in ICU and 177 patients (76.96%) had a stay of < 72 hours.

The mean age of all patients who were involved in this study was 60.72 years. The majority of the participating patients (71.74 %) were male, 31.74% were smokers, and 46.62 % were overweight (all patients in Table 1). The study showed that age (P= 0.40), gender (P= 0.79), occupation (P= 0.10), smoking (P= 0.54), and BMI (P= 0.79) were not the risk factors for a prolonged stay in the ICU among patients undergoing CABG. **(Table 1)**

Table (1): Comparisons of pre-operative demographic characteristics between usual and a long stay in ICU

Characteristics	All patients (n=230)	Length of ICU stay		p-value (two-sided)
		Group A Usual stay (< 72 h) 177 (76.96%)	**Group B Long stay (≥ 72 h) 53 (23.04%)**	
Age (years) mean (SD)	60.72 (9.25)	60.50 (9.22)	61.70 (9.18)	0.4082[a]
Range	37-82	37-81	46-82	
Age category				0.7940[b]
30-40	4 (1.74)	4 (100)	0 (0.00)	
41-50	34 (14.78)	25 (73.53)	9 (26.47)	
51-60	72 (31.30)	56 (77.78)	16 (22.22)	
61-70	86 (37.39)	67 (77.91)	19 (22.09)	
71-80	32 (13.91)	24 (75.00)	8 (25.00)	
81-90	2 (0.87)	1 (50.00)	1 (50.00)	
Sex				0.2933[b]
Male	165 (71.74)	130 (78.79)	35 (21.21)	
Female	65 (28.26)	47 (72.31	18 (27.69)	
BMI				0.7905[b]
Normal weight	40 (17.39)	32 (80.00)	8 (20.00)	
Overweight	107 (46.52)	83 (77.57)	24 (22.43)	
Obese	83 (36.09)	62 (74.70)	21 (25.30)	
Smoking				0.5432[b]
Ex-smoker	4 (1.74)	4 (100)	0 (0.00)	
No	153 (66.52)	117 (76.47)	36 (23.53)	
Yes	73 (31.74)	56 (76.71)	17 (23.29)	
Occupation category				0.1089[b]
Employee	36 (15.65)	32 (88.89)	4 (11.11)	
Self-employee	54 (23.48)	43 (79.63)	11 (20.37)	
Unemployed	140 (60.87)	102 (72.86)	38 (27.14)	

Abbreviations: ICU (intensive care unit) BMI; (body mass index).

a an independent t-test and b Pearson chi-squared tests were performed for statistical analyses. SD (standard deviation)

The correlation between the length of the ICU and comorbidities was not significant. As well, elevated preoperative Troponin (P= 0.33), preoperative low Ejection fraction (P= value 0.81), and preoperative elevated renal function (P=0.33) were non-significantly related to prolonged stay. Both groups were compared the finding showed that the patients with pre-operative MI and elevated preoperative WBC counts were more likely to stay in the ICU for an extended period than those without preoperative MI and elevated preoperative WBC counts; 38.46 % vs. 21.08 %; p= 0.04, 8.89 vs. 8.33; P= 0.03, respectively. But other preoperative features were not shown to be the risk factors for a prolonged stay in ICU. **(Table 2)**

Table (2): Comparisons of pre-operative characteristics between usual and a long stay in ICU

Characteristics	All patients (n=230)	Length of ICU stay		p-value (two-sided)
		Group A Usual stay (< 72 h) 177 (76.96%)	**Group B Long stay (≥ 72 h) 53 (23.04%)**	
IHD				0.7475[b]
No	29 (12.61)	23 (79.31)	6 (20.69)	
Yes	201 (87.39	154 (76.62)	47 (23.38)	
				0.9707[b]
Hypertension	43 (18.70)	33 (76.74)	10 (23.26)	
No	187 (81.30)	144 (77.01)	43 (22.99)	
Yes				
DM				0.3059[b]
No	114 (49.57)	91 (79.82)	23 (20.18)	
Yes	116 (50.43)	86 (74.14	30 (25.86)	
Hyperlipidemia				0.3681[b]
No	198 (86.09)	150 (75.76)	48 (24.24)	
Yes	32 (13.91)	27 (84.38	5 (15.63)	
HF				0.2281[b]
No	226 (98.26	175 (77.43)	51 (22.57)	
Yes	4 (1.74)	2 (50.00)	2 (50.00)	
COPD				0.2281[b]
No	226 (98.26)	175 (77.43)	51 (22.57)	
Yes	4 (1.74)	2 (50.00)	2 (50.00)	
Renal impairment				0.2014[b]
No	223 (96.96)	173 (77.58)	50 (22.42)	
Yes	7 (3.04)	4 (57.14)	3 (42.86)	
RF				0.5460[b]
No	227 (98.70)	175 (77.09)	52 (22.91)	
Yes	3 (1.30)	2 (66.67)	1 (33.33)	
Comorbidity category				0.3251[b]
No comorbidity	2 (0.87)	2 (100.00)	0 (0.00)	
Mono-comorbidity	34 (14.78)	29 (85.29)	5 (14.71)	
Multiple-comorbidity	194 (84.35)	146 (75.26	48 (24.74)	
Pre-operative MI				**0.0474[b]**
No	204 (88.70)	161 (78.92)	43 (21.08)	
Yes	26 (11.30	16 (61.54)	10 (38.46)	
Preoperative Hb (g/dl) mean (SD)	13.65 (1.44) 7.8-17	13.67 (1.38)	13.38 (1.83)	0.2156[a]
Range		7.8-17	8.3-16.8	

Preoperative WBC × 10^9/L	8.46 (2.01)	8.33 (2.00)	8.89 (2.01)	**0.0382**[a]
mean (SD)	3.8-16.6	3.8-16.6	5.7-13.5	
Range				
Preoperative renal function				
(mg/dl) preoperative				
Elevated				
Normal	30 (13.04)	21 (70.00)	9 (30.00)	0.3319[b]
	200 (86.96)	156 (78.00)	44 (22.00)	
Preoperative Troponin				
(ng/ml)				
Negative	200 (86.96)	156 (78.00)	44 (22.00)	0.3319[b]
Positive	30 (13.04)	21 (70.00	9 (30.00	
Preoperative EF (%) mean				
(SD)	50.36 (8.65)	49.74 (9.82)	50.10 (8.18)	0.8123[a]
Range	20-66	20-65	20-66	

Abbreviations: IHD (ischemic heart disease); DM (diabetes mellitus); HF (heart failure); COPD (chronic obstructive pulmonary disease); RF (renal failure); MI (myocardial infarction); HB (hemoglobin); WBC (white blood cell); EF (ejection fraction); g/dl (grams per deciliters); ng/ml (nanograms per milliliter); mg/dl (milligram per deciliter).

a an independent t-test and b Pearson chi-squared tests were performed for statistical analyses.

The red bold numbers show significant differences.

Prolonged ICU stay was significantly increased with increasing the duration of bypass, 129.34 vs. 119.65; p=0.03, while not increased with increasing the aortic cross-clamp time (P-value 0.10). The On-pump surgery was the most prevalent type of CABG, and a combined arterial and venous graft was the most common type of graft that was used in both groups, and the surgery was elective in the vast majority of patients and most patients didn't develop any intraoperative event. None of these variables showed a significant correlation with the length of ICU stay. **(Table 3)**

Table (3): Comparisons of intra-operative characteristics between usual and a long stay in ICU

Characteristics	All patients (n=230)	Length of ICU stay		p-value (two-sided)
		Group A Usual stay (< 72 h) 177 (76.96%)	**Group B Long stay (≥ 72 h) 53 (23.04%)**	
Type of CABG				
Off-pump	29 (12.61)	23 (79.31)	6 (20.69)	0.7475[b]
On-pump	201 (87.39)	154 (76.62)	47 (23.38)	
Timing of surgery				
Elective	177 (76.96)	138 (77.97)	39 (22.030	0.1256[b]
Emergency	8 (3.48)	8 (100.00)	0 (0.00)	
Urgent	45 (19.57)	31 (68.89)	14 (31.11)	
No. of grafts				0.1831[b]
1	8 (3.48)	7 (87.50)	1 (12.50)	
2	19 (8.26)	18 (94.74)	1 (5.26)	
3	82 (35.65)	60 (73.17)	22 (26.83)	
4	90 (39.13)	71 (78.89)	19 (21.11)	
5	25 (10.87)	18 (72.00)	7 (28.00)	
6	6 (2.61)	3 (50.00)	3 (50.00)	
Artery				
No	189 (82.17)	141 (74.60)	48 (25.40)	0.0999[b]
Yes	41 (17.83)	36 (87.80)	5 (12.20)	
Vein				
No	225 (97.83)	174 (77.33)	51 (22.67)	0.3256[b]
Yes	5 (2.17)	3 (60.00	2 (40.00)	
Artery and vein				
No	44 (19.13)	38 (86.36)	6 (13.64)	0.0994[b]
Yes	186 (80.87)	139 (74.73)	47 (25.27)	
Duration of CBP (minute)				
mean (SD)	121.92 (28.24)	119.65 (28.44)	129.34 (26.54)	**0.0392[a]**
Range	49-221	49-189	76-221	
Cross-clamp time (minute)	74.79 (19.17)	73.82 (20.09)	79.13 (16.85)	0.1050[a]
mean (SD)	31-187	31-187	41-151	
Range				
Intra-operative events				0.7667[b]
AF	16 (6.96)	12 (75.00)	4 (25.00)	
No	214 (93.04)	165 (77.10)	49 (22.90)	

Abbreviations: CABG (coronary artery bypass graft); CPB (cardiopulmonary bypass);
[a] an independent t-test and [b] Pearson chi-squared tests were performed for statistical analyses.
The red bold numbers show the significant differences,

In this study, of the 230 participants who received CABG, the mean duration of ICU stay was 2.45 days, ranging from 1 to 13 days, with a mean of 1.95 days in the normal stay groups (< 72 hours), and 4.25 days in the prolonged stay groups (≥ 72 hours), which was statistically significant (p < 0.00). The study found that the patients who stayed longer in ICU had a significantly higher mean value of the duration of intubation (13.13 vs. 9.19; (P=0.00) and a higher postoperative troponin level (3.42 vs. 2.25 (P=0.00). In addition, the patients who had reintubation (83.33% vs. 19.72 (P<0.00), re-operation (72.73% vs. 20.55 (P=0.00), re-admission (95.65% vs. 14.98% (P < 0.00), and the use of inotropic agents in the ICU (36.00% vs. 13.08 (P = 0.00) such as; noradrenaline (36.90 vs. 15.07 (p = 0.00), dobutamine (43.14 vs. 17.32 (P = 0.00) and milrinone infusion (75.00 vs. 22.12 (p = 0.39), were more likely to stay longer at ICU compared to those without these post-operative characteristics, respectively. While the two groups did not differ in other postoperative features. **(Table 4)**

Table (4): Comparisons of post-operative characteristics between usual and a long stay in ICU

Characteristics	All patients (n=230)	Length of ICU stay		p-value (two-sided)
		Group A	**Group B**	
		Usual stay (< 72 h)	**Long stay (≥ 72 h)**	
		177 (76.96%)	**53 (23.04%)**	

Length of ICU stay mean (SD)	2.45 (0.78)	**1.95 (0.22)**	**4.25 (2.10)**	**<0.0001[b]**
Range	1-13	**1-2**	**3-13**	
Duration of intubation (hrs.) mean (SD)	9.99 (7.54)	9.19 (7.34)	13.13 (7.57)	**0.0016[a]**
Range	1-168	1-24	2-168	
Re-intubation				
No	218 (94.78)	175 (80.28)	43 (19.72)	**<0.000[b]**
Yes	12 (5.22)	2 (16.67)	10 (83.33)	
Re-operation				
No	219 (95.22)	174 (79.45)	45 (20.55)	**0.0005[b]**
Yes	11 (4.78)	3 (27.27)	8 (72.73)	
Inotropic Agents				
No	130 (56.52)	113 (86.92	17 (13.08)	**<0.0001[b]**
Yes	100 (43.48)	64 (64.00)	36 (36.00)	
Nor-adrenaline infusion	146 (63.48)	124 (84.93)	22 (15.07)	**0.0002[b]**
No	84 (36.52)	53 (63.10)	31 (36.90)	
Yes				
Dobutamine infusion	179 (77.83)	148 (82.68)	31 (17.32)	**0.0001[b]**
No	51 (22.17)	29 (56.86	22 (43.14	
Yes				
Milrinone infusion				
No	226 (98.26)	176 (77.88)	50 (22.12)	**0.0391[b]**
Yes	4 (1.74)	1 (25.00	3 (75.00	
Hb (post-operative) g/dl mean (SD)	9.80 (1.25)	9.83 (1.27)	9.69 (1.21)	0.5037[a]
Range	7-15.5	7-15.5	7.5-13	
Post-operative WBC × 10^9/L mean (SD)	12.65 (3.36)	12.41 (3.23)	13.14 (3.39)	0.1548[a]
Range	5.9-23.4	5.9-23.4	6.1-20.8	
Post-operative Renal function (mg/dl)	28 (12.17)	21 (75.00)	7 (25.00)	0.7931[b]
Elevated	202 (87.83	156 (77.23)	46 (22.77)	
Normal				
Post-operative Troponin (ng/ml)	2.07 (3.30)	2.25 (1.92)	3.42 (2.64)	**0.0016[b]**
median (IQR)	0.09-27.68	0.087-27.68	0.101-25	
Range				
Post-operative Albumin (g/dl) mean (SD)	3.23 (0.40)	3.26 (0.39)	3.14 (0.43)	0.0661[a]
Range	2.27-4.3	1-3	4-13	
Post-operative Na^+ (mmol/l) mean (SD)	141 (2.76)	140.95 (2.83)	141.16 (2.51)	0.6430[a]
Range	132-172	132-172	132-150	
Post-operative K^+ (mmol/l) mean (SD)	4.06 (0.50)	4.08 (0.51)	3.98 (0.44)	0.1808[a]
Range	2.8-6.1	2.9-6.1	2.8-5.5	
Post-operative				

Ca^{++} (mmol/l)	1.20 (0.08)	1.21 (0.08)	1.19 (0.08)	0.1442[a]
mean (SD)	0.98-1.67	0.98-1.67	1-1.58	
Range				
Re-admission to				
ICU	207 (90.0)	176 (85.02)	31 (14.98)	**<0.0001[b]**
No	23 (10.0	1 (4.35	22 (95.65)	
Yes				

Abbreviations: Na+ (sodium); K+(potassium); Ca++(calcium); mmol /l (millimoles per liter).
a an independent t-test and b Pearson chi-squared tests were performed for statistical analyses.
The red bold numbers show the significant differences,

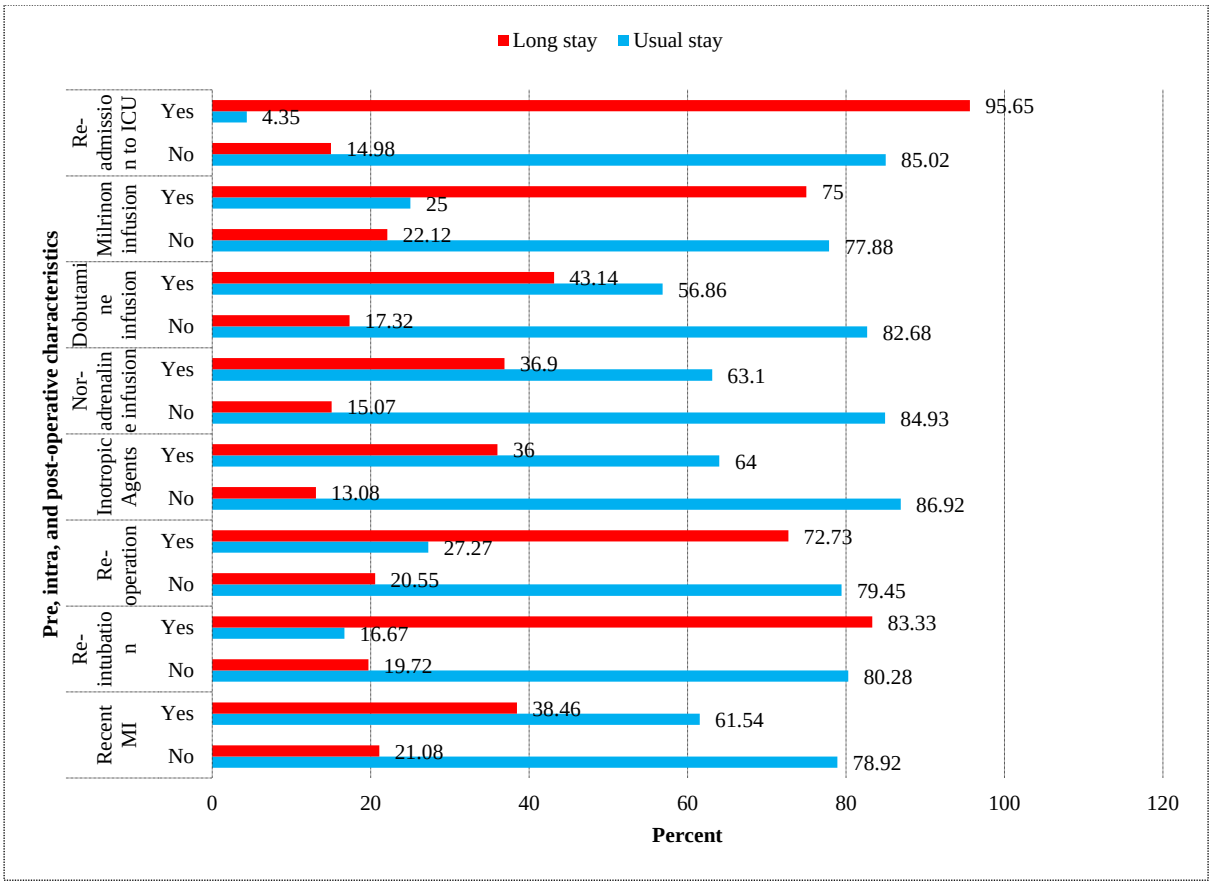

Fig (1): Incidence rates of long and usual stay in patients with pre-, intra-, and post-operative characteristics

The patients who had cardiac complications were more likely to stay longer in the ICU compared to those who had no cardiac complications, 57.14% vs. 21.97%; however, the overall difference was not statistically Signiant (P=0.05). While there was no difference in postoperative bleeding between the two groups (30.00 vs. 22.38; p = 0.43). Patients who developed post-operative complications such as; chest complications, wound complications, and postoperative arrhythmias 40.00% vs. 16.36; p= 0.00, 100 % vs. 19.55; p-value < 0.00, 65.91% vs. 12.90%; p-value < 0.00, respectively, were more likely to stay in the ICU for an extended period compared to those patients who had not developed complications. **(Table 5)**

Table (5): Comparisons of postoperative complications between usual and a long stay in ICU

Characteristics (n=230)	All patients (n=230)	Length of ICU stay		p-value (two-sided)
		Group A Usual stay (< 72 h) 177 (76.96%)	**Group B Long stay (≥ 72 h) 53 (23.04%)**	
Cardiac complications				
No	223 (96.96)	174 (78.03)	49 (21.97)	0.0511
Yes	7 (3.04)	3 (42.86)	4 (57.14)	
Type of cardiac complications				
No				
Cardiac tamponade	223 (96.96)	174 (78.03)	49 (21.97)	**0.0498**
Myocardial Infarction (MI)	3 (1.30)	2 (66.67)	1 (33.33)	
Pericardial effusion	2 (0.87)	0 (0.00)	2 (100.00)	
	2 (0.87)	1 (50.00)	1 (50.00)	
Chest complications				
No	165 (71.74)	138 (83.64)	27 (16.36)	**0.0001**
Yes	65 (28.26)	39 (60.00)	26 (40.00)	
Type of chest complications				
No	165 (71.74)	138 (83.64)	27 (16.36)	**0.0011**
Chest infection	12 (5.22)	6 (50.00)	6 (50.00)	
Plural effusion	16 (6.96)	11 (68.75)	5 (31.25)	
Pulmonary oedema	37 (16.09)	22 (59.46)	15 (40.54)	
Wound complications				
No	220 (95.65)	177 (80.45)	43 (19.55)	**<0.0001**
Yes	10 (4.35)	0 (0.00)	10 (100)	
Type of wound complications				
No	220 (95.65)	177 (80.45)	43 (19.55)	**<0.0001**
Wound infection	10 (4.35)	0 (0.00)	10 (100)	
Arrhythmias				
No	186 (80.87)	162 (87.10)	24 (12.90)	**<0.0001**
Yes	44 (19.13)	15 (34.09)	29 (65.91)	
Type of arrhythmias				
No	186 (80.87)	162 (87.10)	24 (12.90)	**<0.0001**
AF	41 (17.83)	15 (36.59)	26 (63.41)	
Rapid AF	3 (1.30)	0 (0.00)	3 (100)	
Post-operative bleeding				
No	210 (91.30)	163 (77.62)	47 (22.38)	0.4394[b]
Yes	20 (8.70)	14 (70.00)	6 (30.00)	

Abbreviations: AF (atrial fibrillation);.
Pearson chi-squared tests were performed for statistical analyses.
The red bold numbers show the significant differences,

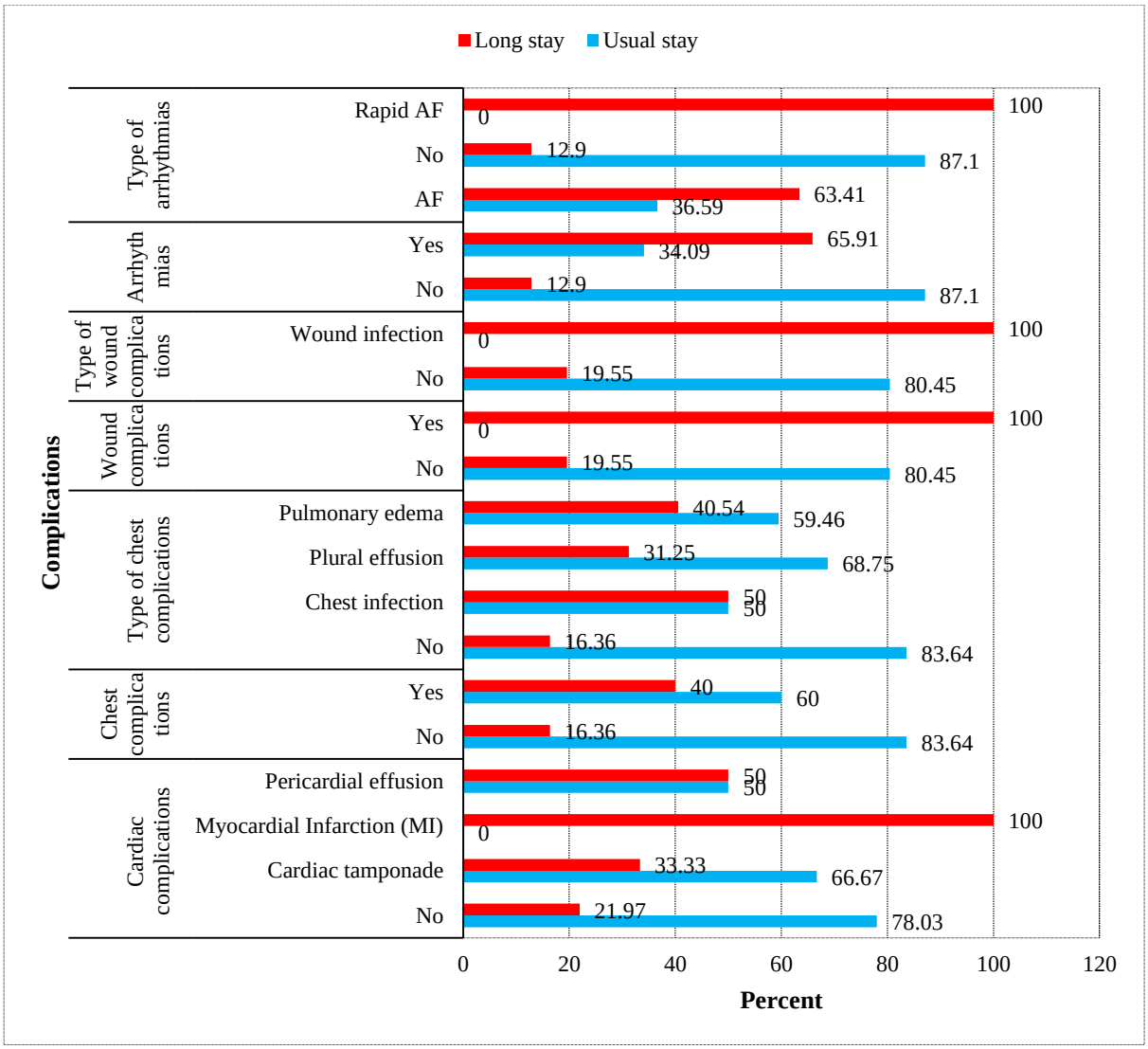

Fig (2): Incidence rates of long and usual stay in patients with and without post-operative complications

DISCUSSION

The findings of this retrospective comparative study included the results on demographic features and perioperative risk factors that affect the ICU length of stay post CABG surgery obtained from 230 participants. In this study, 53 patients (23.4%) had an ICU length of stay ≥ 72 hours, and 177 patients (76.96%) had an ICU length of stay < 72 hours, with the mean duration of ICU stay, was 2.45 days, ranging from 1 to 13 days. There was no statistically significant difference between the men and women. We found that the factors increasing the ICU length of stay after CABG include; preoperative MI, elevated preoperative WBC counts, a prolonged CPB time, prolonged intubation, reintubation, reoperation, readmission, receiving inotropic agents in the ICU, higher postoperative troponin levels, arrhythmias, and the development of postoperative complications, for instance; cardiac, respiratory, and wound complications.

Several studies have been conducted to identify the risk variables that impact the length of a patient's stay in the ICU following CABG surgery. Multiple factors and a wide range of patient conditions make interpreting the influence of each variable difficult. Meanwhile, each of these factors can influence others, either strengthening or weakening their effect (Oliveira et al., 2013).

According to the existing literature and the median value in the researchers' cohort, as well

as at many cardiac surgery centers, the majority (75%) of patients after CABG surgery spend about 24 to 36 hours in the ICU, whereas 25% spend more than 48 hours (Diab et al., 2017, Sadeghi et al., 2019). According to the literature, a lengthy ICU stay duration is accepted to be between 48 hours and 10 days, which is considered a broad range (Almashrafi et al., 2016, Tunç et al., 2018).

Furthermore, Sadeghi F et al, 2019. also conducted a retrospective analysis with 346 patients. It was shown that 27% of patients had an ICU length of stay of ≥ 72 hours, and 73% of patients had an ICU length of stay of < 72 hours. There was no statistical significance difference between men and women, and the variables that enhance ICU length of stay following CABG can be separated into three categories: preoperative, intraoperative, and postoperative. Preoperative factors included old age, a WBC level greater than 10,000 10^9/L, and a decreased left ventricular ejection fraction; intraoperative factors included a prolonged CPB time; and postoperative factors included prolonged intubation, cardiac, pulmonary, and renal complications, postoperative bleeding, receiving inotropic drugs, and receiving blood products (Mahesh et al., 2012, Sadeghi et al., 2019).

The present study faced near this rate with the same definition of prolonged ICU stay and the demographic data, preoperative features of the patients (except for higher WBC count and pre-operative MI) did not lengthen ICU stay.

The patients with preoperative MI were significantly associated with a longer ICU stay. Many studies concluded that preoperative myocardial infarction was the cause of postoperative cardiac function deterioration, and patients with prior MI spent 1.2 days longer in the intensive care unit than others. Furthermore, preoperative MI raises the risk of postoperative complications (Chen et al., 2019).

In line with this study, several studies found that a higher preoperative WBC count was related to a longer ICU. WBCs have an important role in inflammation, influencing the vascular wall, microvascular blood flow, endothelial cells, and endothelial function. Previous research has linked a high WBC count to an increased risk of cardiovascular complications and death following coronary artery bypass graft (CABG) surgery. As a result, preoperative WBC levels may be considered for perioperative care. WBC count influences postoperative clinical outcomes such as atrial fibrillation, duration of stay, readmission rate, and mortality (Kao et al., 2022).

In the majority of other studies, older age was related to prolonged ICU and hospital stays, which is not consistent with this study. The link between older age and longer ICU stay may be related to the elderly's decreased cardiac capacity, increased comorbidities, and disease severity. This decreased health capacity and physical ability can have an impact on surgical recovery and ICU duration of stay, which has been confirmed by the literature (Ganyukov et al., 2020).

In regards to BMI, the current study found that obesity is not an independent factor of extended ICU stay. The possible reason for the non-significant difference in BMI of the current study group backs to the reality that the majority of the patients (46.52 %) were overweight. Obesity was assumed to be a substantial risk factor for individuals receiving heart surgery in prior research. Diabetes, hypertension, and hyperlipidemia are all frequent disorders among obese people. Nonetheless, several studies have demonstrated that there is very little association between obesity and post-operative- operative complications (morbidity and mortality) (Gao et al., 2016, Tafelski et al., 2016).

Many studies revealed that CPB for more than120 minutes increased the likelihood of a longer stay by 2.81 times. Several studies have demonstrated that a prolonged duration of CPB is related to a longer postoperative mechanical ventilator. Therefore, the duration of CPB was considered to be one of the risk factors for prolonged ICU stay. the current findings were consistent with these studies. Lengthy bypass duration has previously been demonstrated to not only lead to the requirement for inotropic support following an extended period of systemic anti-inflammatory response syndrome but also excessive initial bleeding needing re-exploration due to CPB-induced hemostasis defect (Osinaike et al., 2015). Furthermore, Kijjanon and Decbabangklong (2013) observed that patients who did not have cardio-pulmonary bypass had few complications and stayed in the ICU and hospitals for shorter periods than those who did (Kijjanon Deebabanklong, 2013).

Patients on mechanical ventilators (MV) for more than 24hrs were considered a risk factor for longer ICU admission, as previously established in previous research. The MV, on the other hand, is connected with other

characteristics associated with a longer hospital stay. The extended MV is also associated with surgical variables such as aorta cross-clamping, CPB period greater than 120 min, and post-operative events such as lung damage and chest infection. Another research, by Azafarin et al., 2014, found that reduced cardiac output, neuromuscular weakness, and electrolyte abnormalities might be the reasons for extended intubation (Azarfarin et al., 2014, Zhang et al., 2021). which is in line with the current study.

In the current study, the patients who were readmitted to ICU were more likely to stay longer in ICU compared to not re-admitted in the ICU, and the rate of ICU readmission was 10%. This readmission rate appeared to be consistent with other reported trials, which range from 4% to 14%. It is well recognized that readmission to the ICU is frequently linked with higher hospital mortality, a poor long-term prognosis, increased morbidity, and a long time of hospitalization, all of which result in higher expenses. According to the majority of the studies evaluated, the most common reason for ICU readmission was arrhythmias (often atrial fibrillation) (50%) and respiratory problems (30%) (Jarząbek et al., 2014, Gillinov et al., 2015).

In agreement with this study, Michalopoulos et al. and Hein et al. concluded that inotrope usage for LV support, such as dobutamine, noradrenalin, and milrinone infusion, remained substantial risk factors for an extended stay in the ICU. This has been ascribed to a large incidence of open cardiac surgery patients showing with low cardiac output (LCO) early after surgery. LCO is a clinical syndrome induced by a temporary reduction in systemic perfusion caused by cardiac dysfunction. However, it is observed that the number of inotropes, rather than their usage, was the main influence (Sadeghi et al., 2019, Zhang et al., 2021).

Postsurgical complications were discussed less commonly. There were only few studies that investigated post-operative complications (Labata et al., 2018, Ganyukov et al., 2020). Patients with postsurgical complications were predicted to spend more time in the ICU due to the need for management and monitoring. Following, myocardial protection measures, decreasing the length of CPB, managing blood sugar, hemodynamic stability, and early extubation may help to reduce these complications (Morisaki et al., 2016). In agreement with this study, several studies have revealed that pulmonary oedema was the most prevalent post-operative chest consequence, wound infection was the most common wound complication, and AF was the most common kind of arrhythmia (Tunç et al., 2018).

Patients with longer ICU stays were more likely to experience arrhythmia after surgery in the present study. Atrial fibrillation (AF) is the most prevalent arrhythmia seen in patients following CABG surgery, affecting 17.83% of participants in this study. Perrier et al. discovered a prevalence of AF of 21% in their investigation. According to D'Agostino et al., this issue arises in 24.9 % of CABG patients. According to most studies, at least one out of every five patients developed AF following CABG. AF increases hospital stay following CABG and influences other relevant factors. It is a significant cause of ICU readmission following discharge. (Safarpoor et al., 2021, Zhang et al., 2021).

Elevated cardiac troponins have been documented following virtually every cardiac surgery. Furthermore, moderate troponin increases are typical after cardiac surgeries. Troponin levels of more than 0.8 ng/ml are related to an elevated risk of major adverse cardiac events (MACE) in individuals without a previous history of myocardial infarction within 30 days following surgery (Perić et al., 2021). Elevated post-operative troponin levels were shown to be significantly related to a longer duration of stay in this study.

Limitation

This is the first study that has been conducted to determine parameters influencing ICU length of stay (LOS) following CABG surgery in Duhok city. However, the study was not exempt from the limitations. Many studies have indicated various variables as being relevant for a longer stay in the ICU following CABG surgery. Comparisons between these studies are difficult due to differences in the kind and number of independent factors included in each study.

Furthermore, the use of varied cut-offs to define a long stay in the ICU (from 2 to 14 days) has contributed to the difficulties. The bulk of these studies covered preoperative factors and, in general, did not consider events that impact patient outcomes during surgery or the early postoperative period. Due to the retrospective nature of the current study, some of the study population's data were incomplete and the

medical records were not properly stored. Therefore, we have eliminated some cases from the analysis due to a high level of missing information.

CONCLUSION AND RECOMMENDATION

Conclusion: Preoperative factors included a history of recent MI and elevated preoperative WBC counts; intraoperative factors included a prolonged CPB time; and postoperative factors included prolonged intubation, reintubation, reoperation, readmission, receiving inotropic agents in the ICU, arrhythmias, higher postoperative troponin levels, and the development of postoperative complications, were associated with a prolonged ICU stay. Recognizing the above-mentioned variables by ICU physicians and nurses may assist in the early identification of patients at high risk of prolonged ICU stay.

Recommendation

This study suggests the potential for enhanced efficiency in perioperative care may be contributing to the successful recovery of CABG patients. In addition, particular attention should be paid to signs during early postoperative monitoring to assist in the correction of arrhythmia as soon as possible, preserve the stability of respiratory circulation, and reduce complications. Furthermore, advancements in surgical procedures, equipment, and care may result in positive outcomes even in the most high-risk patients.

More research is needed because this is a multifaceted issue. If additional research resources are available, case-matched, nested approaches to control some aspects for model creation and validation of the predictive model in a different sample can contribute more to real quality and ongoing quality improvement in CABG care. Furthermore, future research must address the index's deployment in practice.

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