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Original Article

Impact of COVID-19 Infection on Outcome of Cardiac Surgery patients in Tertiary Cardiac Care Hospital

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ABSTRACT

Objective: To determine the impact of COVID-19 infection on outcome of cardiac surgery patients.
Study Design: Comparative Cross-sectional study.
Place and Duration of Study: Cardiac Surgery Department, Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi Pakistan, from Jul 2020 to Jun 2022.
Methodology: All patients who underwent cardiac surgery were included. 1370 patients were recruited through non-probability consecutive sampling, which were further divided into three groups depending upon the COVID-19 infection as no COVID-19, post COVID-19 and active COVID-19 infection groups. The groups were compared for in-hospital mortality and morbidity of the cardiac surgery. Descriptive and inferential statistics were calculated by applying Chi-square test to compare the groups.
Results: Out of 1370, Group-A (no COVID-19) had 1055(77.0%) patients, group-B (post COVID-19) had 296(21.6%) patients and group-C (active COVID-19) had 19(1.4%) patients. Male cases were 977(71.3%) and females were 393(28.7%). 759(55.4%) patients underwent conventional CABG, 327 (23.9%) had off-pump CABG and 284 (20.7%) had valve replacement surgery. On comparing these three groups for outcome, statistically significant findings were found. Morbidity in terms of renal derangement (p<0.001), respiratory illness (p<0.001), cardiac failure management (p<0.001), and mortality (p<0.001) was higher in patients of post COVID-19 and active COVID-19 group.
Conclusion: Cardiac surgery with COVID-19 infection leads to high mortality and morbidity rate as compared to patients with no COVID-19 infection. Pulmonary complications in post-operative cardiac patients with COVID-19 were the major challenge to deal with.

Key words: Cardiac Surgery, Complications, Coronary Artery Bypass Graft, COVID-19.

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INTRODUCTION

Worldwide Cardiovascular diseases are the leading cause of death, especially in low-and middle-income countries. Secondary to lack of healthcare services especially cardiac surgery infrastructure, human resources, and financial coverage, majority of population could not access it.[1] Recently, the healthcare industry has been facing COVID-19 pandemic challenges. During Pandemic, the primary focus has been on the COVID-19 and its management, There is paucity of information related to surgical services especially cardiac surgery and effect of COVID-19 infection on patient outcome.[2] Cardio-thoracic practices may not be in the front-line of the COVID-19 response but have responded to the demands of pandemic and in doing so it has been affected considerably. Worldwide reduction in cardiac surgery of 50-75% has been identified.[2] The Centers for Disease Control and Prevention (CDC) recently published recommendations for the care of patients undergoing surgical procedures during the COVID-19 pandemic.[3,4] Additional modifications provided by the American College of Surgeons offer further guidance for surgical patients and personnel.[5] Both organizations have recommended significant reduction of elective cases and implemention of logical, tiered general precautions. The society of thoracic surgeons COVID-19 task force and the workforce for adult cardiac and vascular surgery published patient triage guidance.[6] Other suggestions from the American College of Surgeons to enhance safety for healthcare workers,[5] in the context of COVID-19 to consider non-operative management whenever it is clinically appropriate for the patients to complete testing as close to the planned operative date as preferably <48 hours to decrease the risk of a patient to become positive while waiting for a surgical procedure.[7]

As COVID-19 is new in our lives and the available current data relating to COVID-19, mostly include small studies concentrating on outcome of COVID-19

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positive patients following various surgical procedures including thoracic and orthopedic surgery. These early studies concluded that surgery in COVID-19 positive patients has a high risk of mortality and surgery may accelerate disease progression in those incubating COVID 19.[8-10] However, very few studies focusing on effects of COVID-19 on cardiac surgery have been published especially in our country. The purpose of this study was to describe and explore effects of COVID-19 on cardiac surgery outcomes before, during and after pandemic at a Tertiary Cardiac Care Setup.

METHODOLOGY

A Comparative Cross-sectional study was conducted at Adult Cardiac Surgery Department of AFIC/NIHD Rawalpinid Pakistan, from 01 Jul 2020 to 30th June 2022. Data was collected retrospectively through non-probability consecutive sampling technique.

The study was initiated after taking formal permission from Institutional Ethical Review Board under letter no. (IERB # 9/2/R&D/2022/210).

A sample size of 335 patients was calculated using online open epi sample size calculator, taking 32% prevalence of cardiac surgery patients who require surgical intervention in low-to middle-income countries at 95% Confidence Interval and 5% Margin of error.[11] However, data was collected from 1370 patients.

Inclusion Criteria: Patients irrespective of age and gender who underwent cardiac surgery (SVCAD, DVCAD, TVCAD & isolated uni-valve repair/ replacement), LVEF >45% and <10% HbA1c value were included.

Exclusion Criteria: Patients who underwent emergency surgery, concomitant surgery, dual valve replacement, poor LV, diffuse TVCAD needing endarterectomy, CKD (eGFR<40ml/min), peripheral vascular disease, TIA and stroke in last 6 months and patients with history of severe COVID-19 infection needing hospitalization/ventilatory support were excluded.

Data was extracted from the database of Adult Cardiac Surgery Department, AFIC/NIHD after taking formal permission from the respective authority. Confidentiality and anonymity of the data was maintained. Data was used only for the purpose of research. We recruited a total of 1370 patients, which were further grouped into three groups, depending upon the exposure to COVID-19 infection. Group-A (n=1055): no exposure to COVID-19 before or after surgery, Group-B (n=296): patients who were exposed, diagnosed and treated for COVID-19 infection at home 4-6 weeks prior to surgery and Group-C (n=19): diagnosed as COVID-19 positive after surgery on the basis of clinical symptoms, haemdynamics and PCR, but negative PCR prior to surgery. All patients undergoing any type of cardiac surgery procedure were admitted 48 hours prior to surgery and screened for COVID-19 infection by Polymerase Chain Reaction (PCR) on nasopharyngeal samples. These groups were compared for the morbidity (cardiovascular, respiratory, renal, stroke, ICU and hospital stay) and mortality after the cardiac surgery.

Data was analyzed by using Statistical Package for Social Sciences (SPSS) version-23. Descriptive statistics were applied to calculate frequency (percentage) for variables like age, gender, type of surgery and post-operative complications like respiratory complications, renal complications, neurological complications, Intensive care (ITC) stay, ventilation time, mortality etc. Pearson's Chi-square test was applied to calculate the association between study groups with other demographic, per-operative and post-operative variables. *p*-value ≤0.05 was considered significant.

RESULTS

A total of 1370 patients were included in the study which were grouped into Group-A, 1055(77%), Group-B, 296(21.6%) and Group-C, 19(1.4%) patients (Figure-1).

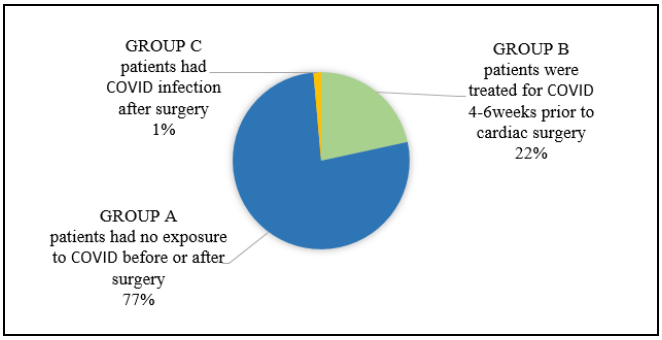

Figure-1: Grouping of Study participants on the basis of COVID-19 infection (n=1370)

Out of 1370, 927 (67.7%) patients were ≤60 years and 443(32.3%) patients were >60 years of age. 977(71.3%) were male and 393(28.7%) were female. 759(55.4%) patients underwent Conventional CABG, 327(23.9%) had Off-pump CABG (OPCAB) and 284(20.7%) had Valve replacement surgery.

Table–I: Comparison of COVID-19 Infection Groups with Demographics, Pre-Op & Post Op Complications (n=1370)

Variables		COVID-19 INFECTION GROUPS			*p*-value
		Group-A (No Exposure to COVID 19 Before or After Surgery) (n=1055) Frequency(%)	Group-B (Treated for COVID-19 4-6 Weeks Prior to Surgery) (n=296) Frequency(%)	Group-C (COVID-19 Positive After Surgery) (n=19) Frequency(%)	
Age	≤60 years	714(67.7%)	203(68.6%)	10(52.6%)	0.35
	>60 years	341(32.3%)	93(31.4%)	9(47.4%)	
Gender	Male	780(73.9%)	184(62.2%)	13(68.4%)	<0.001
	Female	275(26.1%)	112(37.8%)	6(31.6%)	
Type of Surgery	Con CABG*	580(55.0%)	169(57.1%)	10(52.6%)	<0.001
	OPCABG*	212(20.1%)	111(37.5%)	4(21.1%)	
	Valve replacement	263(24.9%)	16(5.4%)	5(26.3%)	
Ventilation Hours	< 6hours	392(37.2%)	112(37.8%)	04(21.1%)	<0.001
	> 6hours	189(17.9%)	84(28.4%)	15(78.9%)	
	Within 3 hours	474 (44.9%)	100 (33.8%)	--	
Types of Respiratory Complications					
Acute Respiratory Distress Syndrome (ARDS)		166(15.7%)	100(33.8%)	15(78.9%)	<0.001
Consolidation/ collapse/ effusion		47(4.5%)	24(8.1%)	04(21.1%)	<0.001
Respiratory complication		213 (20.2%)	124(41.9%)	19(100%)	<0.001
Renal Complications					
Pharmacological treatment		260(24.6%)	91(30.7%)	11(57.9%)	<0.001
HD/CRRT		51(4.8%)	14(4.7%)	04(21.1%)	0.006
None		744(70.5%)	191(64.5%)	04(21.1%)	<0.001
Cardiac Failure Management					
< 2 inotropic supports (mild & moderate)		592(56.1%)	135(45.6%)	3(15.8%)	<0.001
> 2 inotropic supports (High)		393(37.3%)	151(51.0%)	15(78.9%)	<0.001
IABP		70(6.6%)	10(3.4%)	1(5.3%)	0.11
Neurological Complications					
Psychosis/delirium		225(21.3%)	81(27.4%)	6(31.6%)	0.06
Stroke		50(4.7%)	6(2.0%)	--	0.07
None		780(74%)	209(70.6%)	13(68.4%)	0.46
Intensive Care (ITC) Stay					
<3 days		656(62.2%)	129(43.6%)	--	<0.001
3-10 days		374(35.5%)	146(49.3%)	12(63.2%)	<0.001
10-40 days		25(2.4%)	21(7.1%)	7(36.8%)	<0.001
Re-Ventilation		64(6.1%)	47(15.9%)	14(73.7%)	<0.001
Tracheostomy		29(2.7%)	11(3.7%)	7(36.8%)	<0.001
Mortality		60(5.7%)	23(7.8%)	12(63.2%)	<0.001

**ConCABG: Conventional CABG, OPCAB: Off-pump CABG*

Table-I shows most of the study population was below 60 years of age 927(67.7%). Out of 977(71.3%) male patients, only 13(1.3%) were COVID positive after cardiac surgery, while majority had been treated for COVID-19 infection 4-6 weeks prior to surgery (p<0.001). Most of the study participants 169(57.1%) who underwent conventional CABG belonged to group-B (Treated for COVID 4-6 weeks prior to surgery) and it was statistically significant (p<0.001).

When compared the groups with post op complications all of the grouping variables had significant findings except neurological complication (p<0.05). Study participants of group-B & group-C had high mortality and morbidity rate as compared to group-A (Table-I). When comparing the ventilation time, mostly patients of group-A had ventilation time within 3 hours 474(44.9%), while the ventilation time of majority patients of group-C was >6 hours. Mostly patients of group-C were re-ventilated 14(73.7%) and only few patients of group-A re-ventilated 64(6.1%). Mortality rate of group-A was lower than group-B and it was significant (p<0.001). Intensive care (ITC) stay

was higher in group-C, none of the patient of group-C had ITC stay less than 3 days 7(36.8%) (p<0.001). Similarly other complications including renal derangement, respiratory illness and cardiac failure were higher in patients of post COVID and in active COVID patients and were statistically significant (Figure-2).

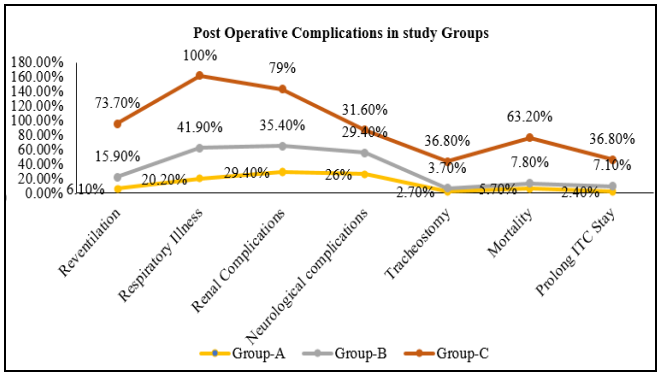

Figure-2: Post-operative Complications among Study Groups (n=1370)

As depicted in Table-II, mortality rate was relatively lower in study population (95; 7.27%) but was higher in older age group (>60 years) i.e. 58(61.1%) with significant findings (p<0.001). When we compared mortality in three groups with post op complications, the findings were statistically significant (p<0.001).

DISCUSSION

Pandemic has overwhelmed health care systems and disrupted routine care internationally. The impact of the COVID-19 pandemic on patient outcomes is still not well documented.[12] In current study, 927(67.7%) patients were ≤60 years and 443(32.3%).

Table-II: Comparison of Mortality with Post Operative Complications (n=95)

Variables		Grouped Mortality			p-value
		Group A (n=60)	Group B (n=23)	Group C (n=12)	
Age	≤60 years	28(3.0%)	4(0.4%)	5(0.5%)	<0.001
	>60 years	32(7.2%)	19(4.3%)	07(1.6%)	
Respiratory complications		36(10.1%)	20(5.6%)	12(3.4%)	<0.001
Renal complications		40(9.3%)	19(4.4%)	11(2.6%)	<0.001
Neurological complications		48(13.0%)	16(4.3%)	04(1.1%)	<0.001
Tracheostomy		16(34.0%)	02(4.3%)	07(14.9%)	<0.001
Re-ventilation		26(20.8%)	09(7.2%)	11(8.8%)	<0.001

Patients were >60 years. Most of our study population were males i.e., 977(71.3%) and 393(28.7%) were females. Results of our study suggested that mortality rate was higher in patients of group-C i.e. 63.2% (p<0.001). The comparison of mortality with respiratory illness had significant findings (p<0.001). This might be due to the reason that patients develop multiple complications after cardiac surgery.

Generally, older patients (60 years and above) who underwent major surgeries are particularly at high risk of morbidity, mortality, however during pandemic all type of surgeries were associated with higher morbidity and mortality rate.[13] In the entire COVID-19 cohort in China, the proportion of severe and critical diseases was 27.3% and 36.4% respectively after chest surgery. It gives the impression that SARS-CoV-2 significantly increased the risk of death in postoperative patients.[14] The 2019 NELA report presented 30-day mortality rates of 16.9% for patients at high preoperative risk of death, 16.8% for patients with unexpected ICU admission, and 23.4% for frail patients over 70 years of age.[15] The mortality rate among older patients (>60 years) reported in the current study was 4.3% among post COVID group and 1.6% among active COVID group. The difference in findings may be that we only included the in-hospital mortality rate, while other studies focused 30 days mortality and they included patients of 70 years and above, while we grouped elder patients as >60 years.[15]

Julie Sanders *et al*. compared cardiac patients with and without COVID-19, and reported longer post-operative hospital stay of 6-11 days (p= 0.001) and increased mortality (p< 0.0001).[16] These findings were similar to our data i.e. 63.2% of mortality rate with pulmonary complications and 36.8% patients with COVID-19 infection had longer ICU stay (>10 days) with significant findings. In a similar study by Ruan *et al*., 58% cardiac patients died from respiratory failure. A general trend of tachy-arrhythmias was observed overall in cardiac patients with COVID-19.[17] Mortality in patients with COVID infection was mainly high among those who had postoperative pulmonary complications, which accounted for approximately 50% of the patients. This rate is well above pre-pandemic baseline level of 8%.[14,18]

According to Biccard BM *et al*. ARDS had the highest mortality rate of 63% than other complications (<0.05).[19] Likewise in our study, 15(78.9%) patients with COVID-19 infection developed ARDS (p<0.001), which is quite near to the reported literature and all of

the patients who developed pulmonary complications and expired belong to active COVID group. Same findings reported by Lei *et al*. suggested 100% postoperative pneumonia in 34 asymptomatic COVID-19 patients undergoing elective surgery.[9] Nahshon C *et.al*. studied the data on the postoperative outcome of patients diagnosed with COVID-19 patients who developed pulmonary complications and had higher morbidity and mortality rate.[20] In particular, COVID-19 patients with pre-existing cardiovascular disease had higher mortality and morbidity rates.[21]

LIMITATIONS OF STUDY

This study was confined to single center, which can be its limitation. In view of high morbidity, it is always recommended to give time to patients for recovery so they are well stabilized and rehabilitated prior to surgery. Cardiac surgery is a major undertaking so for optimal outcomes, these patients should be followed with proper medical therapy, chest rehabilitation with physiotherapy and general health improvement. Improvement in screening test and personal protective measures should be followed at all levels for safety.

CONCLUSION

Outcome of cardiac surgery patients is affected by SARS-COV-19 infection. Cardiac surgery with COVID-19 infection leads to high mortality and morbidity rates. Patients with no COVID-19 infection pre and post-surgery had less morbidity(complications) and low mortality rate. Pulmonary complications in post-op patients with COVID-19 were the major challenge to deal with.

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Conflict of Interest: None

Authors' Contribution

Following authors have made substantial contributions to the manuscript:

FS & VIP: Manuscript writing, study design, critical review, approval of the final version to be published.

MW & RU: Data interpretation, critical review, study concept, data collection, approval of the final version to be published.

AN: Formatting of content, data collection, review of article.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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