

Performing Cardiac Surgery during COVID-19

by Yan Efrata Sembiring

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Performing cardiac surgery during COVID-19 pandemic in Surabaya, Indonesia: A single-center retrospective observational study

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Yan Efrata Sembiring¹ , Puruhito Puruhito¹, Heroe Soebroto¹, Agung Prasmono¹, Arief Rakhman Hakim¹, Oky Reviyanto Sediono Pribadi¹, Dhihintia Jiwangga Suta Winarno¹, Danang Himawan Limanto¹, Erdyanto Akbar¹, Rafaela Andira Ledyastatin¹ , and Muhammad Caesar Borni Agustio Putra Hutabarat¹

Abstract

Background: Healthcare workers are still the front liners in health care services, and have major roles during the COVID-19 pandemic. In a resource-limited country like Indonesia, it is necessary to provide safe screening and management both for patients and healthcare workers to minimize the transmission. We report our experience in the cardiac surgery department on how to provide safe management during the COVID-19 pandemic.

Methods: A retrospective observational study was performed in a single-tertiary-center cardiac surgery department in Surabaya and included all patients who underwent cardiac surgery during the first year of the COVID-19 pandemic. We also collected the patients from a 1-year period before the pandemic as the comparison data. Analysis of the patient characteristics, operative data, and postoperative outcome, was performed. This study also provides our experience in changes of admission in the cardiac surgery preoperative system that can be utilized for others.

Results: A total of 179 patients were admitted to and had cardiac surgery. Of these, 3.80% ($n=7$) were COVID-19 confirmed by a real-time polymerase chain reaction. Five patients were delayed to have cardiac surgery with no mortality or morbidity reported in these patients. During the period after changes of admission procedural in cardiac surgery patients, there were no healthcare workers infected by COVID-19 by patient transmission in our center (0%).

Conclusion: Our study reported a systematic screening and that possible delay in cardiac surgery appears to be feasible and safe, both for patients and for healthcare workers during the COVID-19 pandemic.

Keywords

COVID-19 pandemic, cardiac surgery, perioperative care, healthcare worker safety

Introduction

Healthcare workers (HCWs) are still the front liners in health care services, having major roles and responsibilities to assess and manage patients during the coronavirus infection disease 2019 (COVID-19) pandemic.¹ However, the incidence of HCWs infected with COVID-19 had been reported to increase in several countries (Italy, China, UK).^{1,2} Indonesia is one of the developing countries in Asia which has the highest number of confirmed COVID-19 cases and which have been gradually growing since the transmission.³ Consequently, there is a much higher risk to HCWs in Indonesia to get COVID-19.

Unfortunately, there are still no data on the total number of COVID-19 cases in Indonesia HCWs, but the prediction is still increasing.

¹Department of Thoracic, Cardiac and Vascular Surgery, Faculty of Medicine, Universitas Airlangga/Dr Soetomo Academic General Hospital, Surabaya, Indonesia

Corresponding author:

Rafaela Andira Ledyastatin, Dr Soetomo Academic General Hospital, Thoracic, Cardiac and Vascular Surgery Department, Medical Faculty of Universitas Airlangga, Surabaya, East Java, Indonesia.
Email: rafaela.andira@yahoo.com

A statement from China's National Health Commission showed more than 3300 HCWs had been infected from early March to the end of February, and nearly 22 HCWs had died.⁴ Similar to Indonesia, 24 doctors died from COVID-19 in the first month of the COVID-19 pandemic.⁵ In September 2020, Indonesia, became the fourth-highest fatality rate of HCWs according to Amnesty International and Our World in Data.⁶ Unfortunately, the latest data show a significant inflation per January 1st, 2021 as drastically reported by the government with 549 HCWs deaths caused by COVID-19.⁷ HCWs' safety procedure and an investigation into the deaths of HCWs are urgently needed to protect the right of all HCWs while providing health care services. Based on a previous study, exposure to unrecognized COVID-19 patients has been the most prominent cause of HCWs getting infected by COVID-19.⁸

One study in China reported a coronavirus infection that emerged from the operating theater.⁵ The conclusion showed that HCWs, including cardiac surgeons, can get infected and transmit the virus to others. Screening systems play a crucial role on how to prevent the transmission of COVID-19 from patients to HCWs.⁶

Hence, several studies had described recommendations about how to conduct safe screening and management, especially to HCWs, during the COVID-19 pandemic.^{3,6} However, the guideline might not be easily transferable because healthcare systems are highly variable in terms of their structure and workforce composition.

Therefore, the implementation of recommendations is needed to adapt based on the capability in every single center.

The COVID-19 pandemic also had an implication on the number of cardiac surgery cases. Previous multicenter studies stated a significant decline of cases compared to before the pandemic era.⁹ No previous research was conducted to evaluate the characteristic of cardiac surgery cases in Indonesia during the COVID-19 pandemic.

This study aims to evaluate the cardiac surgery cases in the first year of the COVID-19 pandemic in our

center, Dr Soetomo Academic General Hospital, Surabaya. Furthermore, to share our experience on what and how we perform safe in-hospital strategy during the pandemic, as a protection of our HCWs, mainly the cardiac surgery team.

Materials and methods

This is a single-center retrospective observational cohort study of all patients admitted and having cardiac surgery from 1 March 2020 to 1 March 2021 in our center. This period was included as the COVID-19 period group. The 1-year period before the date of 1 March 2021 was included as the pre-COVID-19 group. No exclusion criteria were applied. Data were gathered retrospectively from our department pre-operative assessment database, electronic patient management systems, and electronic patient discharge summaries. The COVID-19 period and the pre-COVID-19 period were compared. Patient characteristics (age; gender; comorbidity; Dr Soetomo EWS category;

Table 2. Demographic.

Characteristics	Era		p-value
	Pre-COVID-19 n = 378	COVID-19 n = 179	
Age (mean ± SD)	34.2 (1.8)	33.1 (1.7)	0.10
Median (range), y	36 (0.1–73)	35 (0.6–79)	
Gender (%)			0.22
Male	199 (52.65)	93 (51.96)	
Female	179 (47.35)	86 (48.04)	
Setting (%)			0.009
Elective	346 (91.54)	157 (87.71)	
Urgent	25 (6.61)	17 (9.5)	
Emergent	7 (1.859)	5 (2.79)	
Category (%)			0.01
Non-trauma	373 (98.68)	177 (98.89)	
Trauma	5 (1.32)	2 (1.1)	
Comorbidity (%)			0.07
Yes	98 (25.93)	24 (13.40)	
Current smoker (%)	14 (3.7)	8 (4.47)	
Diabetes (%)	21 (5.55)	18 (10.05)	
Hypertension (%)	25 (6.61)	13 (7.26)	
Cerebrovascular disease (%)	14 (3.7)	10 (5.59)	
Peripheral vascular disease (%)	13 (3.43)	7 (3.91)	
Pulmonary hypertension (%)	11 (2.91)	10 (5.59)	
No	280 (74.07)	155 (86.6)	

Table 1. Characteristics in the COVID-19 period.

Characteristics	n = 184
Dr Soetomo EWS category (%)	
Low risk	1 (0.5)
Moderate risk	182 (89.9)
High risk	1 (0.5)
COVID-19 status (%)	
Positive	7 (3.8)
Negative	179 (97.3)
Chest X-ray interpretation (%)	
Non-pneumonia	166 (90.2)
Pneumonia	18 (9.8)

EWS: early warning sign.

SD: standard deviation.

COVID-19 status; Chest X-ray interpretation), surgical variables (diagnosis; surgical case; type of procedure; setting of surgery; category of diagnosis; CPB time, AOX time), and outcome variables (LOS, clinical outcome mortality rate, COD) were obtained. All data were handled in Microsoft Excel (Microsoft, Inc., Redmond, USA). Data were analyzed for characteristics presented as mean \pm standard deviation. Statistical analysis was carried out using SPSS v25 (SPSS, Chicago, IL).

Results

Patient characteristics

During the first year of the pandemic, 184 patients were recorded in our cardiac surgery database. In the

Table 3. Diagnosis and procedure.

Characteristics	Era		p-value
	Pre-COVID-19 n = 378	COVID-19 n = 179	
Diagnosis (%)			0.05
VSD	66 (17.46)	34 (19)	
ASD	47 (12.43)	27 (15.09)	
TOF	33 (8.73)	12 (6.70)	
PDA	12 (3.17)	5 (2.80)	
Other congenital malformation of heart	15 (3.97)	10 (5.59)	
Coronary artery disease	131 (34.65)	52 (29.05)	
Valvular heart disease	45 (11.90)	28 (15.64)	
Endocarditis	5 (1.32)	2 (1.11)	
Benign neoplasm of heart	15 (3.96)	2 (1.11)	
Others	9 (2.38)	7 (3.91)	
Procedure (%)			0.02
VSD closure	66 (17.46)	34 (19)	
ASD closure	47 (12.43)	27 (15.09)	
Total correction TOF	30 (7.93)	7 (3.91)	
PFO creation	3 (0.8)	3 (1.67)	
Modified BT shunt	4 (1.05)	5 (2.80)	
PDA ligation	12 (3.17)	8 (4.46)	
CABG	131 (34.65)	52 (29.05)	
Heart valvular repair	28 (7.40)	8 (4.46)	
Heart valvular replacement	17 (4.50)	20 (11.17)	
Pacemaker implantation	10 (2.64)	5 (2.80)	
Heart tumor excision	15 (3.96)	2 (1.12)	
Pericardiectomy	7 (1.85)	2 (1.12)	
Debridement	5 (1.32)	2 (1.12)	
Other	3 (0.8)	4 (2.23)	

VSD: ventricular septal defect; ASD: atrial septal defect; TOF: tetralogy of Fallot; PDA: patent ductus arteriosus; BT Shunt: Blalock-Taussig shunt; CABG: coronary bypass graft.

preoperative screening process, seven patients (3.80%) were COVID-19 confirmed by RT-PCR swab test (Table 1). Due to the COVID-19 status, these patients were delayed to have cardiac surgery. After a period of self-quarantine, two patients were continued to have CABG. The remaining patients ($n=5$) were remain delayed (Table 1). The characteristics were three patients delayed to had CABG, one pediatric patient of atrium septal defect, and one patient of mitral valve replacement.

The characteristics of 179 patients who had cardiac surgery in the first-year pandemic period are shown in Table 2. We also collected the previous database between March 1, 2019, and March 1, 2020, as the comparison. We found 378 patients had cardiac surgery in our center (Table 2). The comparison of total patients that had cardiac surgery between this two-period was found in significant changes ($n=378$ vs. $n=179$; $p=0.005$). The mean patients' age was similar in two periods (34.2 (± 1.8) vs. 33.1(± 1.7)). Although quite similar to the female, predominance was male (52.65% vs. 51.96%). The monthly average number of cases was calculated as 31 patients (378 patients in 12 months) before the COVID-19 pandemic and 15 patients (184 patients in 12 months) during the COVID-19 pandemic. The setting was dominant in the elective setting (Pre-COVID-19; $n=346$, 91.54%; COVID19 $n=157$, 87.71%). The comparison between the two periods had no significant difference regarding the age ($p=0.10$) and gender ($p=0.22$) distribution of the patients. The distribution of the main heart disease and procedures is shown in Table 3. No significant change was observed in categories of heart disease ($p=0.02$) and heart surgeries ($p=0.03$) between the two periods in this study. During the COVID-19 period, the most common disease was coronary artery disease ($n=52$, 29.05%), ventricular septal defect in 34 patients (19%), and valvular heart disease in 28 patients (15.64%). It was similar to pre-COVID-19 period with the domination of coronary artery disease in our subjects (34.65%). Other diagnoses were found in seven patients during the COVID-19 period; two patients with atresia pulmonary artery, two patients with AV block, two patients with pericarditis, and one patient with infection of the prosthetic heart valve. The most frequent type of procedure in the COVID-19 period was coronary bypass graft in 52 cases (29.05%). Mean cardiopulmonary bypass time was 102 (range 0–328 min). The mean aortic cross-clamp time was 66 (range 0–93 min).

During the COVID-19 period, Dr Soetomo Academic General Hospital was encountered a scoring system to evaluate of early detection of the COVID-19 pandemic. It was applied to all of our patients during the pandemic as our screening tools for patient admission (Figure 1). As shown in Table 1, the EWS category of our patients was dominantly at moderate risk ($n=182$, 89.9%). Only one (0.5%) patient was found in the high-risk category according to our EWS scoring system. No mortality and morbidity

were reported during the delay of cardiac surgery procedures within these patients (Table 4). Among the patients in the COVID-19 period, 9.8% ($n = 18$) had pneumonia in chest X-ray imaging.

Clinical outcomes of post-operative cardiac surgery patients

The comparison of the postoperative clinical outcomes can be seen in Table 5. In the pre-COVID-19 period, patients were hospitalized for a median of 4 (IQR: 0–28) days. The magnificent changes found during the COVID-19 period increased 2.25% (9, IQR: 0–34) from the period of pre-COVID-19. No significant rate was found between the two periods in complication ($p = 0.03$), aorta cross-clamp time ($p = 0.48$), cardiopulmonary by-pass time ($p = 0.26$). The mortality rate during the COVID-19 period was 3.35%. It was similar to the pre-COVID-19 period (2.91%) with the most common cause of death was a cardiogenic shock ($n = 3$, 1.68% vs. $n = 4$, 1.06%).

COVID-19 status of HCWs in TCVS department

During the COVID-19 pandemic, screening systems are vital. HCWs were checked routinely as to the detection of any transmission of COVID-19 in the hospital area. During one year of the COVID-19 pandemic in our center, we had no HCWs or cardiac surgery operative team infected by patient–doctor transmission; especially in cardiac surgery theatre (Table 6; $n = 80$).

Discussion

Preoperative strategy: screening method prior to cardiac surgery

Our study shows that dominantly our subjects were at “moderate risk” on Dr Soetomo EWS scoring for COVID-19 (Figure 1). Among the population, we found seven subjects tested positive for COVID-19. However, according to the EWS scoring that was used, only one patient (0.5%) was stated as “high risk.” If EWS scoring is considered as a single method of COVID-19 screening, it doesn’t alleviate the anxiety levels amongst HCWs, since a possibility to be infected by an asymptomatic COVID-19 patient remains. Besides, the other six patients were found in “moderate risk” or “low risk.” Therefore, the need to conduct screening and obligatory RT-PCR swab test in our center as a screening strategy.

The COVID-19 pandemic has affected a range of aspects of the healthcare system and left no option but to plan changes in patient management in hospitals including the management of preoperative for cardiac surgery.¹⁰ Systematic and effective screening systems are needed to

decrease the transmission of the coronavirus, especially among HCWs since they have become the frontline during the pandemic.³


Before the pandemic, in an elective setting, the admission of the patient before cardiac surgery only took one day before the surgery in our center. Since the pandemic, 3–4 days were needed to work up the screening procedure and other examinations according to the needs of the surgery. The screening procedure, such as the RT-PCR swab test must be done at two different times. The first is after the admission, and the second is 24 h after the first result of the RT-PCR swab. Negative results, both at the first and second tests, are needed to attain the requirement of safe cardiac surgery in Dr Soetomo Academic General Hospital.¹¹

After the patient is registered for elective cardiac surgery admission, they will be brought to an isolation buffer room. This buffer room is one of the crucial elements in the prevention of COVID-19. The aim is to separate patients who are COVID-19-negative from patients whose COVID-19 infection status is still unknown.


Two designated units of trained medical personnel perform the swab in pairs. They don level III personal protective equipment (PPE), which consists of a fit-tested disposable head cap, N95 respirators mask, goggles, face shield, long-sleeved gowns, apron, double-layered gloves, and protective footwear to attain maximum droplet and contact isolation protection. The previously described PPE is followed as directed by the guidelines for the prevention and control of coronavirus disease 2019 (COVID-19).^{11,12} Both the nasopharyngeal and oropharyngeal swabs must have been done in every patient. After taking the sample, the specimen is transported to the lab to be processed, the swab unit doffing, and followed by complete personal hand hygiene. If a positive result is obtained, the screening unit re-assesses symptoms that may represent the symptoms of COVID-19. If the patient has symptoms, the patient will be transferred to a specific isolation room for COVID-19 and will be treated as a COVID-19 patient. If the symptoms are not discovered, the patient can do self-isolation at home under health care supervision.¹¹

We found seven patients (3.80%) were COVID-19-positive. Two patients were admitted to an isolation room in the hospital (room for infectious disease) due to the symptoms that were needed to be directly supervised by HCWs. After the treatment and stated as negative COVID-19 patients, these two patients took a further examination of preoperative objective assessment related to cardiac surgery protocols in our center for COVID-19 survivors as shown in Figure 2 to have elective cardiac surgery as necessitated.

Five others were placed in self-isolation and temporarily did not give consent to do cardiac surgery due to avoiding accessing the hospital because of fear of COVID-19 in



Rapid Screening Corona Virus Disease (COVID-19)
Emergency Department and Outpatient Clinic Department
Dr Soetomo General Academy Hospital



Mayor	Score	Notes
1. S/O: History of contact with Confirmed COVID-19 Patient (without Standard PPE) plus ≥ 1 Minor objective finding criteria	When Major Criteria 1-3 has Found at least 1 Criteria or more, Score= 20	Rapid Screening is done by using information (anamnesa, Physical Examination, and others objective data that available for determine the risk scaling of covid-19. In advance investigation, Scale of COVID-19 Risk will be update with other additional informations. This Goal of Rapid Screening is to guarantee the health worker and Hospital environment safe.
2. O: Chest Röntgen : Consolidation In bilateral pulmonary basal consolidation		
3. O: CT Scan: Ground Glass Phenomenom Bilateral		
Minor	Score	
1. S: Working/Attending in massive mass gathering, praying place, party, or public place facility (Bank, Airport),etc	When Minor Criteria 1-4 has Found at least 1 Criteria or more, Score= 4	
2. S: Stay in or away in confirmed as infected place (domestic or international)		
3. S: Family member working or traveling to confirmed infected place or have a local transmission	When Minor Criteria 5-8 has Found at least 1 Criteria or more, Score= 4	
5. S/O: Fever/ History of fever in the last 14 days (≥37.5 °C)		
6. S/O: Anosmia (Loss of smell)	When Minor Criteria 5-8 has Found at least 1 Criteria or more, Score= 4	
7. S/O: Gastrointestinal Syndrome (Diarrhea, Nausea, vomit, Abdominal pain)		
8. S/O: Airway Syndrome (Cough, cold, breathless)	1	
9. O: Comorid Factors (DM, HT, CKD, Malignancy, Autoimun, Heart Disease, Obesity, Pregnancy)	1	
10. O: Leukopenia (<5000/cnm)	1	
11. O: NLR (Neutrophyl Lymphocyte Ratio) >3,5	1	
12. O: Absolute Lymphocyte Count <1100	1	
13. O: Trombositopenia (<180.000)	1	
14. O: CRP (>5x Normal)	1	
15. Chest Röntgen : Bilateral Pulmonary Consolidation	1	
16. Chest Röntgen : Bilateral Difuse Pulmonary Consolidation	1	
17. Chest Röntgen : Unilateral Pulmonary Consolidation	1	
18. Chest Röntgen : Bilateral Central Pulmonary Consolidation	1	
19. S: History of contact with Confirmed COVID-19 Patient (without Standard PPE) without another finding	10	

Notes:
Scoring Criteria for Suspected Covid-19 Patients
 Score 1-4 : Low Risk
 Score 5-19 : Moderate Risk
 Score ≥ 20 : High Risk

Figure 1. Rapid screening coronavirus disease (COVID-19) emergency department and outpatient clinic department Dr Soetomo Academic General Hospital. Every patient, chaperon, and visitor does rapid screening (early warning sign—EWS) when admitted to hospital.

contagious places such as the hospital. Several hypotheses have been postulated to explain this avoiding accessing the hospital during the pandemic.¹³ The fear of COVID-19 made patients delaying the visit to the hospital. Patients might perhaps obtain treatment with alternative medical and interventional therapy, obviating the need for surgery. Patients who developed symptomatic relief may decide to withdraw the consent to pursue aggressive treatment in the future. Other patients may be reluctant to incur out-of-pocket costs during this time of financial difficulty that might be caused by the pandemic.¹³

Meanwhile, in other 179 patients with COVID-19 negative findings could proceed with the cardiac surgery as scheduled before and continued to further regular examinations prior to cardiac surgery such as complete counting blood count, echocardiography, catheterization (if needed), etc.

The COVID-19 screening system benefits: intraoperative aspects & HCWs safety

The use of PPE during surgery presents its difficulties, especially in major operations such as heart surgery. Besides the

risk of fallacy during operation due to the limitations made from the usage of PPE, it can also affect HCWs' safety due to the extended time of level III PPE usage while performing the procedure. A previous study has reported a survey explaining the results of an extended PPE usage causing discomfort in HCWs, such as heat stroke, thirst, pressure effect on skins (such as laceration), headaches, and extreme exhaustion.¹⁴

During the pandemic, a screening system based on the results of the RT-PCR swab examination in preoperative management may provide great relief for HCWs in providing services.¹⁵ The negative result of the RT-PCR swab is a mandatory preoperative requirement in our center. Depending on the good result of the screening, the cardiac surgery team of Dr Soetomo General Academic Hospital proceeds with the surgery using level II PPE protection, including a disposable surgical cap, N95 mask, surgical mask, and disposable latex gloves during the COVID-19 pandemic. This is according to the guideline that is given by the Indonesia Ministry of Health guidelines described in the "Pedoman Pencegahan dan Pengendalian Coronavirus Disease 2019" in performing health care services, HCWs can use level II PPE for patients with negative findings of COVID-19, including heart surgery

Table 4. Mortality and morbidity rate in delayed elective cardiac surgery on confirmed COVID-19 patients.

Characteristic	n = 5
Mortality (%)	
Yes	0 (0)
No	5 (100)
Morbidity (%)	
Yes	0 (0)
No	5 (100)

COVID-19: coronavirus infection disease 2019.

procedure.¹² Considering the morbidity of proceeding cardiac surgery in COVID-19 confirmed patients it can result in significant complications such as acute respiratory distress syndrome (ARDS), shock, acute and cardiac injury as shown in previous literature, which can lead to mortality,¹⁶ Dr Soetomo General Academic Hospital decided to not proceed the cardiac surgery for COVID-19 confirmed patients. The main reason is for the safety of the patient and also for the safety of HCWs to minimize the transmission while the pandemics are

Table 5. Clinical outcome.

Characteristics	Era		p-value
	Pre-COVID19 n = 378	COVID19 n = 179	
Total hospital length of stay (median, IQR)	4 (0–28)	9 (0–34)	0.17
AOX time (median, IQR)	61 (0–89)	66 (0–93)	0.48
CPB time (median, IQR)	89 (0–292)	102 (0–328)	0.26
Complication (%)			0.03
No	327 (86.50)	150 (83.8)	
Yes	51 (13.50)	29 (15.08)	
Post-operative bleeding (%)	5 (1.32)	4 (2.23)	
Stroke (%)	3 (0.79)	5 (2.80)	
AKI (%)	15 (3.97)	12 (6.70)	
ARDS (%)	5 (1.32)	10 (5.59)	
AF (%)	11 (2.91)	6 (3.35)	
HF (%)	7 (1.85)	5 (2.80)	
Wound infection (%)	5 (1.32)	11 (6.14)	
Clinical outcome (%)			0.07
Survive	367 (97.09)	168 (93.85)	
Mortality	11 (2.91)	6 (3.35)	
Cause of death (%)			0.49
Respiratory failure	3 (0.79)	1 (0.56)	
Cardiogenic shock	4 (1.06)	3 (1.68)	
Septic shock	2 (0.53)	1 (0.56)	
Brain failure	2 (0.53)	1 (0.56)	

SD: standard deviation; h: hours; min: minute; AOX: aorta cross-clamp; CPB: cardiopulmonary bypass; AKI: acute kidney injury; ARDS: acute respiratory distress syndrome; AF: atrial fibrillation; HF: heart failure.

Table 6. HCWs infected COVID-19 in the TCVS department.

Characteristic	n = 80
HCWs confirmed of COVID-19	
Yes (%)	0 (0)
No (%)	80 (100)

HCWs: healthcare workers; TCVS: thoracic cardiac vascular surgery; COVID-19: coronavirus infection disease 2019.

still occurring, especially in developing countries like Indonesia with its limitation of facilities and HCWs resources. Surgical interventions in COVID-19 patients may lead to contamination of the operating room and surgical equipment which present a higher risk of transmission of the infection to HCWs and other patients in the hospital.¹⁶ The more exposure to COVID-19 patients, the greater the risk HCWs are transmitted COVID-19.¹⁶ Based on our findings, we proudly reported that, among 80 HCWs in our cardiac team, 0% COVID-19 was confirmed or no HCWs were found infected during providing services in the hospital. Limited resources centers should manage protocol effectively and safely for HCWs, in this way it will decrease harm to front-liners while providing services in the pandemic era.

Postoperative outcome

Although one study had reported nosocomial infection of coronavirus from one patient to the other was about 41% of patients in Wuhan,¹⁷ we found no cases were positive confirmed COVID-19, and no case was found having complication caused by COVID-19 in our center. The complication was relatively minimal in 15.8% related to comorbidity to the patient. Limitation of visitors was made in our center, with only one chaperone accompanying patients and who would also need to be screened like an admitted patient with RT-PCR swab test to warrant the prevention of nosocomial infection. An alternative communication platform was established to help patients keep in touch with loved ones during their stay. Furthermore, they should be restricted to certain areas and should wear masks, gloves, and gowns. Escalating the infection control measures has been proved to prevent nosocomial transmission of COVID-19.¹⁷

LOS was one of the perioperative outcomes. In this study, we used the total of hospitalization LOS as a variable to show the influence of the COVID-19 pandemic in our hospital. Statistically, the mean of total LOS in our center was 11.6 (\pm 1.5) days, compared to the previous study in Tobago and Trinidad which was found only in 5.7 (\pm 1.8) days.¹⁸ Similar to the study from Shahian et al.¹⁹ the hospital LOS for 53% of 496,797 isolated CABG was 5 days. The explanation of the extended the total of hospital LOS may be found in preoperative management which took more days in the hospital LOS.



DR SOETOMO GENERAL ACADEMIC HOSPITAL
PROTOCOL FOR THE PREOPERATIVE OBJECTIVE ASSESSMENT OF COVID-19 SURVIVORS,
STRATIFIED BASED ON NATURE PLANNED SURGERY AND DEGREE OF INDEX ILLNESS



Test	Minor Procedures and/or General Anesthesia		Major Procedures	
	Asymptomatic	Symptomatic	Asymptomatic	Symptomatic
CXR	No- if Pulmonary exam and O2 Saturation Normal	No- if Pulmonary exam and O2 Saturation Normal	Yes	Yes
ECG	Yes	Yes	Yes	Yes
Echocardiography	No- if Cardiac Exam and Vitals normal	No- if Cardiac exam, NT Pro BNP, and Vitals normal	No- if Cardiac exam, NT Pro BNP, and Vitals normal	Determined by H&P
CMP	Yes	Yes	Yes	Yes
CBC with diff	Yes	Yes	Yes	Yes
PTT	No	Consider based on Severity Illness	Yes	Yes
D-Dimer	No	Yes	Yes	Yes
Fibrinogen	No	Consider based on Severity Illness	Yes	Yes
NT-Pro BNP	No	Yes	Yes	Yes
LDH, Ferritin, Pre-albumin	No	Consider based on severity of illness	No	Consider based on severity of illness

Figure 2. The preoperative objective assessment of COVID-19 survivors. Stratified based on nature planned surgery and degree of index illness.

The mortality rate during the pandemic was relatively low at 3.26% in our hospital. The highest cause of death was a cardiogenic shock in three cases (1.63%). The COVIDSurg Collaborative had shown the increased mortality and respiratory complications associated with perioperative COVID-19 infection. According to the study, 280 patients (24.8%) had an elective surgery from multi-center hospitals with a 21.4% of mortality rate.²⁰ Supported by the previous study, exposing cardiac patients especially elective patients to the hospital environment will potentially increase their risk of COVID-19 infection and can do harm to our patients. Also, protecting the institution and society at large by reducing the number of cardiac surgical procedures will result in the preservation of valuable resources. Using the data of five patients who were postponed in our center, the results were no morbidity and mortality (0%) in our cases. This may be insignificant for several reasons. The mortality and morbidity rely on the characteristic of the subjects such as comorbidity, severity, and other aspects which may contribute to worsening the symptoms of subjects.

Screening for HCWs in Dr Soetomo Academic General Hospital

One of the situations that can prevent the spreading of COVID-19 is controlling the healthcare workers' conditions.² The triage scheme in our center in Figure 3 shows as a prevention method of the spread of COVID-19 among the HCWs in our center. The prevention is according to hospital policy and the Indonesia Ministry of Health regulation. When the healthcare workers are

contacted with suspected, probable, and confirmed COVID-19 patients, they will be directed to a medical check-up unit, undertaking a health evaluation including anamneses, physical examination, laboratory testing, radiology examination, and also RT-PCR swab test. Furthermore, screening for the risk of infection is periodically generated every one month with Dr Soetomo EWS and antigen swab test. If the HCWs are stated as negative COVID-19 status with no symptoms, they can continue to provide health services. When positive results have occurred, HCWs must self-isolate for a certain period. After 14 days of self-isolation, HCWs must do another RT-PCR to evaluate their status. If the result is negative, HCWs can return to provide health services, but if they have symptoms with negative findings on the RT-PCR swab, they will be treated based on the severity of the symptoms or do another period of self-isolation. Since the pandemic, usage a surgical mask for controlling the risk of infection, using an N95 respirator or higher level of PPE is a must not only for the post-confirmed COVID-19 HCWs but also all HCWs. Providing safe work environment is an obligation for all HCWs, supporting each other of HCWs must be continued until the pandemic's over.¹¹

We acknowledge the limitations of our approach. This study was a single-center study with a small sample size without strict inclusion and exclusion criteria. The small number may be caused by the fear of COVID-19 exposure in the hospital by our patients. Therefore they rather delayed coming to our out-clinic resulting in a reduction of cardiac surgery in our center. Our center relied on a



DR SOETOMO GENERAL ACADEMY HOSPITAL
HEALTH CARE WORKERS TRIAGE DURING COVID-19 PANDEMIC

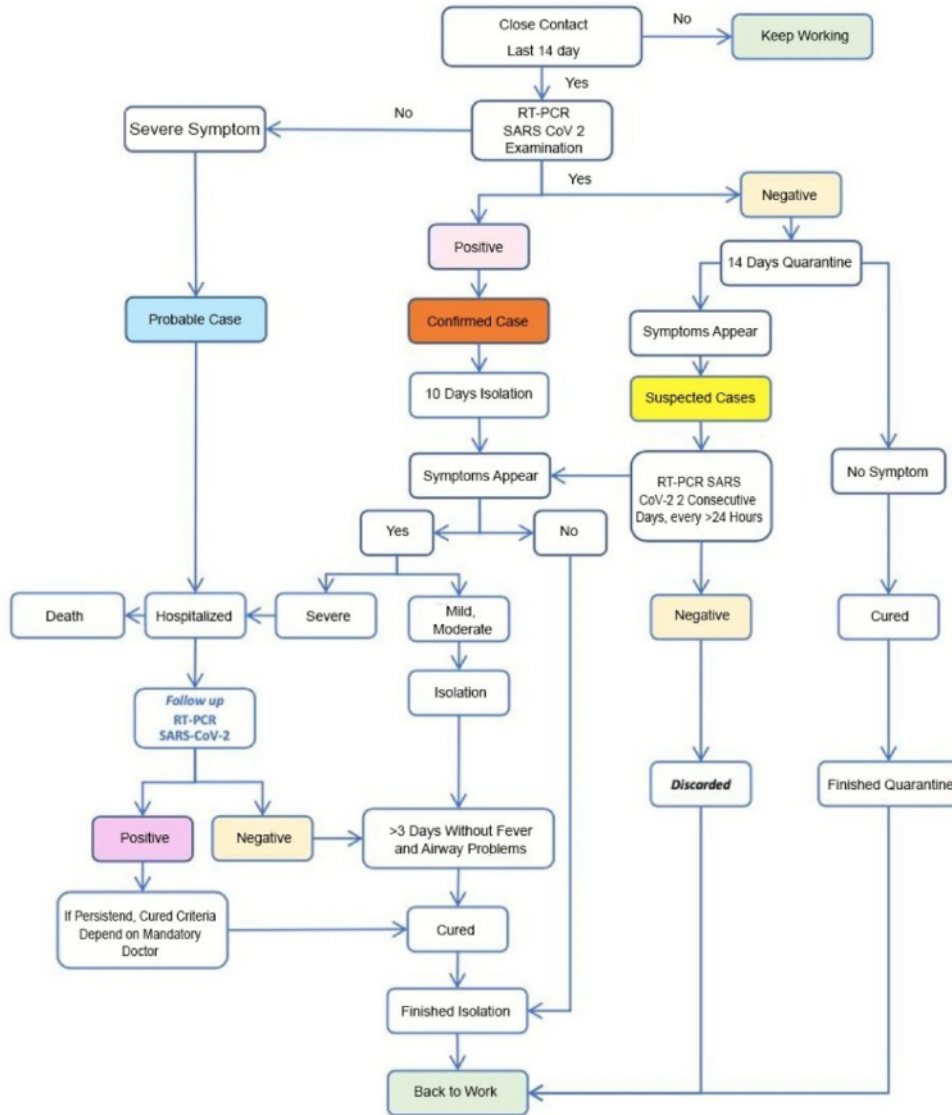


Figure 3. Dr Soetomo Academic General Hospital healthcare workers triage during COVID-19 pandemic. Close contact criteria described when HCW contact probable or confirmed COVID-19 patients in 1 m radius and for 15 min or more. Severe symptoms are there are one or more symptoms of COVID-19 like cough, fever, throat hoarseness, headache, malaise, nausea, vomit, diarrhea, accompanied by respiration rate 33 times per minutes, $SpO_2 < 93\%$ on room air, $PaO_2/FiO_2 < 300$ mmHg, and chest X-ray show infiltrate figure $> 50\%$. The suspected case is someone with flu-like symptoms and a history of traveling in the last 14 days of living in a local transmission area. A probable case is a suspected case with severe flu-like symptoms (RR > 30 \times /min, $SpO_2 < 93\%$ in room air, infiltration $> 50\%$ on chest X-ray examination, and ARDS), EWS score system > 20 , and without RT-PCR result. A confirmed case is someone with a positive real-time polymerase chain reaction (RT-PCR) result.

measure of RT-PCR swab only with a reported sensitivity of 78%.¹² However, to our knowledge, the results of our study provide the first evidence that preoperative strategy could not only be safe for HCW's safety but also effectively safe for conducting elective cardiac surgery during the pandemic. These results hopefully will lead to consensus on the management of cardiac surgery during the COVID-19 pandemic.

Conclusion

Screening procedure appears to play a crucial role in the precaution of COVID-19 transmission, and surgical delay may be feasible (if needed) and safe both for patients and healthcare workers, considering the urgency of surgery and the risk of COVID-19 transmission are necessary; during the COVID-19 pandemic.

Abbreviations and Acronyms

ASA	American Society of Anesthesiologist
AOX	Aorta Cross Clamp
APSF	America Patient Safety Foundation
CDC	Center for Disease Control and Prevention
COD	Cause of death
COVID-19	Coronavirus Infection disease 2019
CPB	Cardiopulmonary By-pass
ED	Emergency department
EWS	Early warning signs
HCW	Healthcare workers
LOS	Length of stay
PPE	Personal protective equipment
RT-PCR	real-time polymerase chain reaction
TCVS	Thoracic, Cardiac, and Vascular Surgery.

Authors' contributions

Yan Efrata Sembiring and Puruhito: contribution to the conception and design of the work. Acquisition, analysis, and interpretation of data. Draft and final approval of the final version and responsible for all aspects of the work; Heroe Soebroto and Agung Prasmono: contribution to the conception and design of the work. Analysis and interpretation of data. Draft and final approval of the final version and responsible for all aspects of the work; Arief Rakhman Hakim, Oky Revianto Sediono Pribadi, Dhihintia Jiwangga Suta Winarno, Danang Himawan Limanto, Erdyanto Akbar: contribution to the acquisition of data. Draft and final approval of the final version and responsible for all aspects of the work; aspects of the work; Rafaela Andira Ledyastatin and Muhammad Caesar Borni Agustio Putra Hutabarat: contribution to the conception and design of the work. Analysis and interpretation of data. Draft and final approval of the final version and responsible for all aspects of the work.

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Informed consent

The informed consent was waived, considering that this study involves only data collection.

ORCID iDs

Yan Efrata Sembiring  <https://orcid.org/0000-0002-1712-1816>
Rafaela Andira Ledyastatin  <https://orcid.org/0000-0003-4777-5922>

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