

World Journal of *Virology*

World J Virol 2021 May 25; 10(3): 86-136



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INDEXING/ABSTRACTING

The WJV is now abstracted and indexed in PubMed, PubMed Central, China National Knowledge Infrastructure (CNKI), and Superstar Journals Database.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: Yan-Xia Xing, Production Department Director: Xiang Li, Editorial Office Director: Jin-Lei Wang.

NAME OF JOURNAL

World Journal of Virology

ISSN

ISSN 2220-3249 (online)

LAUNCH DATE

February 12, 2012

FREQUENCY

Bimonthly

EDITORS-IN-CHIEF

Mahmoud El-Bendary, En-Qiang Chen

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/2220-3249/editorialboard.htm>

PUBLICATION DATE

May 25, 2021

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PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/gerinfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/gerinfo/239>

ONLINE SUBMISSION

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Chest radiography requirements for patients with asymptomatic COVID-19 undergoing coronary artery bypass surgery: Three case reports

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Author contributions: Omar AS performed the concept, writing and manuscript revision; Shoman B performed the study design, contribution to the concepts and revising the final form; Sudarsanan S performed the data management and manuscript revision; Shouman Y performed the critical revision and cases review; all authors read and approved the final manuscript.

Supported by Hamad Medical Corporation.

Informed consent statement: All study participants or their legal guardian provided informed written consent about personal and medical data collection prior to study enrolment. This study was approved by medical research center in Hamad Medical Corporation. The ethical committee in Hamad medical corporation approved the study (reference number MRC 04-20-586), all study data were maintained anonymously.

Conflict-of-interest statement: The

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Abstract

BACKGROUND

The coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2, represents a major challenge to health care systems both globally and regionally, with many opting by cancelling elective surgeries. Cardiac operations in patients diagnosed with COVID-19 have been imperative due to their emergency nature, critical condition of patients awaiting cardiac surgery, and accumulated number of cardiac surgical interventions throughout the last months.

CASE SUMMARY

Here we describe three COVID-19 positive cases who underwent coronary surgery, on an urgent basis. We did not experience worsening of the patients' clinical condition due to COVID-19 and therefore a routine post-operative chest X-ray (CXR) was not required. None of the health care providers attending the patients endured cross infection. Further trials would be needed in order to confirm these results.

CONCLUSION

While the pandemic has adversely hit the health systems worldwide, cardiac surgical patients who concomitantly contracted COVID-19 may undergo a smooth post-operative course as a routine post-operative CXR may not be required.

authors declare that they have no competing interests.

CARE Checklist (2016) statement:

The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

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Manuscript source: Invited manuscript

Specialty type: Virology

Country/Territory of origin: Qatar

Peer-review report's scientific quality classification

Grade A (Excellent): A
Grade B (Very good): B
Grade C (Good): C
Grade D (Fair): 0
Grade E (Poor): 0

Received: January 6, 2021

Peer-review started: January 6, 2021

First decision: January 25, 2021

Revised: February 3, 2021

Accepted: March 31, 2021

Article in press: March 31, 2021

Published online: May 25, 2021

P-Reviewer: Wang XJ, El-Bendary M

S-Editor: Fan JR

L-Editor: A

P-Editor: Xing YX



Key Words: COVID-19; Cardiac surgery; Outcome; Radiography; Critical care; Case report

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Core Tip: Routine chest radiology is considered one of the core components of the post-operative care in cardiac surgery settings, there may be additional benefits in patients with associated coronavirus disease 2019 (COVID-19) infection to check the possible lung involvement. However, we found that routine chest radiology may not be required for post-operative care in COVID-19 patients undergoing cardiac surgery. This may reduce overall costs and radiographer's unnecessary exposure.

Citation: Omar AS, Shoman B, Sudarsanan S, Shouman Y. Chest radiography requirements for patients with asymptomatic COVID-19 undergoing coronary artery bypass surgery: Three case reports. *World J Virol* 2021; 10(3): 130-136

URL: <https://www.wjgnet.com/2220-3249/full/v10/i3/130.htm>

DOI: <https://dx.doi.org/10.5501/wjv.v10.i3.130>

INTRODUCTION

The World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) as a global pandemic in March 2020, after the disease swept across the world from its epicenter in Wuhan, China. The disease represented a major challenge for the public and healthcare community globally[1]. The pandemic overwhelmed the health systems, forcing major changes in the health care practices[2]. Under the pressure from acute bed shortage, many health care facilities opted to defer elective surgical procedures[3], consequently, cardiac surgery elective services were forced to be canceled or postponed[4]. Shoman *et al*[5] reported that urgent cardiac in patients with COVID-19 without pneumonia could be carried out safely without further complications or health care associated cross infection, if strict infection control protocols would be enforced during the procedure[5].

The explosive and uncontrolled spread of COVID-19 globally made it imperative for the cardiac surgery societies to release guidelines and protocols aiming to risk assess protocols based on probabilities and resources[6]. Here we describe three COVID-19 positive cases, with no pulmonary-related symptoms, diagnosed with significant coronary artery disease and subsequently subjected to urgent coronary surgery. This manuscript also sheds light on the role of routine chest radiology in perioperative management.

CASE PRESENTATION

Chief complaints

Case 1: A 43-year-old gentleman was presented to the hospital with recent onset chest pain.

Case 2: A 50-year-old gentleman was presented to the emergency cardiac department with acute onset of severe chest pain.

Case 3: A 47-year-old gentleman came to the emergency room with typical post-prandial chest pain.

History of present illness

Case 1: The patient's 12-lead electrocardiogram (ECG) indicated a non-ST segment elevation myocardial infarction (NSTEMI). Subsequent coronary angiography revealed critical left main coronary artery distal occlusion with additional three vessels coronary artery disease (CAD), all of which were severely occluded.

Case 2: The patient's 12-lead ECG showed anterior wall ST segment elevation myocardial infarction (STEMI). Subsequent coronary angiography revealed left main coronary artery disease, left anterior descending, and left circumflex coronary artery disease. Patient's routine swab was positive for COVID-19, but no respiratory symptoms noted. Chest radiology was normal.

Case 3: The working diagnosis after evaluating his 12-ECG was NSTEMI. Coronary angiography detected significant three vessels CAD and patient was referred for urgent surgical revascularization.

History of past illness

Case 1: Patient's past medical history included type II-diabetes mellitus, smoking, and dyslipidemia.

Case 2: Unremarkable past medical history.

Case 3: Patient's medical history was significant for diabetes mellitus, hypertension, smoking, and dyslipidemia.

Physical examination

Case 1: None.

Case 2: The patient's pre-procedure examination was unremarkable. The vital signs showed temperature of 37.1 °C, blood pressure of 127/77 mmHg, heart rate of 87 beats/min regular, and oxygen saturation of 98% on supplemental oxygen flow at 2 liters/min delivered *via* nasal cannula.

Case 3: The patient pre-procedure examination was unremarkable. The vital signs showed temperature of 36.8 °C, blood pressure of 107/67 mmHg, heart rate of 77 beats/min regular, and oxygen saturation of 97% on room air.

Laboratory examinations

Case 1: Routine nasopharyngeal swab was positive for COVID-19 after admission, without respiratory symptoms or chest roentgenogram findings.

Case 2: Patient's routine swab was positive for COVID-19, no respiratory symptoms noted, and normal chest radiology.

Case 3: Similar to the previous two patients here studied, a positive swab for COVID-19 was taken, without additional clinical or radiologic manifestations.

FINAL DIAGNOSIS

Cases 1 and 3: Acute NSTEMI with three vessels disease. Patient positive for COVID-19.

Case 2: Acute STEMI with three vessel disease. Patient positive for COVID-19.

TREATMENT

Case 1: The patient subsequently underwent urgent surgical revascularization with three grafts. Full personal protective equipment (PPE) was used, with the anesthesia team taking a lead in the operating room team preparation and theatre. Patient followed a dedicated predesigned transport from and to the operating room and the cardiothoracic intensive care unit (ICU) for post-operative recovery.

Case 2: Patient underwent urgent surgical revascularization under the departmental predesigned guidelines for surgical management of COVID-19 patients. Post-operatively, patient's disposition was carried out in an isolation room of the cardiothoracic ICU (CTICU) and extubated within six hours of admission on the same day.

Case 3: Patient underwent on-pump coronary artery bypass graft and the procedure was uneventful.

OUTCOME AND FOLLOW-UP

Case 1: Patient's post-operative course in the CTICU was uneventful, after removal of the chest drain patient was discharged to the dedicated COVID-19 high dependency unit within the hospital for a short stay, in order to optimize COVID treatment. Patient was subsequently discharged home on the seventh post-operative day.

Case 2: The patient remained in the unit until removal of the chest drain and then transferred to the dedicated isolation ward in the hospital. Later, the patient was discharged home for self-quarantine, on the eight post-operative day, and subsequently followed up by routine telephonic consultation without any reported surgical complications.

Case 3: Patient was extubated on the same operative day in the CTICU and transferred to an isolation room on the ward in the first post-operative day, where cardiac rehabilitation was completed. Patient was then discharged for self-quarantine for 14 d.

No chest radiography was required in the aforementioned three patients (Table 1).

DISCUSSION

The challenge of handling urgent surgeries alongside COVID-19 diagnosis is of limited familiarity amongst practitioners. Decision making and risk assessment protocols can define COVID-19's influence on cardiothoracic surgical outcomes. The three patients here referred are examples of patients who had been through pragmatic decision making protocols to perform such surgeries. The apparent medical stability of these patients, from a respiratory standpoint, encouraged our team to act towards treating the patient's acute coronary syndrome, reducing possible related mortality and morbidity.

Anticipating the need to operate COVID-19 patients, our department developed a protocol for perioperative management of COVID-19 patients undergoing cardiac surgery, which was reviewed by all stakeholders. Furthermore, our team followed patients with COVID-19 after cardiac surgery with a chest radiology when clinically indicated as per the CTICU protocol. This was successfully carried out for all three patients here reported, without any significant clinical issue compromising the patient's outcome.

Triaging and routine testing

Reducing unnecessary chest radiology is a widely agreed goal in the post-operative care of patients after cardiac surgery. Tolsma *et al*[7] made an observational study with 1102 patients aiming to define clear indications for chest X-ray (CXR) after cardiac surgery. This practice was safe and effective in reducing the total number of CXRs performed and also anticipated increased efficacy[7]. Similarly, Forouzannia *et al*[8] reviewed 118 patients who underwent off pump coronary surgeries and their post-operative outcome did not change when CXR were eliminated in the post-operative period[8].

In our organization, we have defined certain criteria for chest radiography during post-operative cardiac surgical care. This included clinical evaluation-based findings of fever, dyspnea, abnormal pulmonary sounds, signs and symptoms of cardiac tamponade, abnormal chest tube bleed or air leak, and doubtful position of endodontically treated teeth and vascular lines. Hypoxia on pulse oximeter ($\text{SaO}_2 < 92\%$ on regular oxygen therapy) and multiple punctures during central venous access also mandated CXR. A final clinical evaluation focused on X-ray findings. All patients were discharged 5-7 d after surgery. A 30-d follow-up included at least two visits. Patients were in constant contact with the cardiac clinic. Symptomatic patients were selectively re-examined to rule out complications.

Decision to operate

In our tertiary center, we have set up a multidisciplinary team approach before deciding to surgically operate on COVID-19 positive patients. This team involved anesthesiologists, cardiac surgeons, cardiologists, and infectious diseases specialists. Asymptomatic but serologically positive COVID-19 patients underwent management as actively infectious. To all these patients the use of full PPE was mandatory[9]. The coronary lesions' anatomical complexity in all three patients here studied were treated as meaningful and consequently conceived to be subjected to operation. Significant left main disease or acute coronary syndrome not amenable to percutaneous intervention

Table 1 Description and outcome of the studied patients

	Case 1	Case 2	Case 3
Age	43	50	47
BMI (kg/m ²)	27.4	24.7	27.1
Creatinine (micromole/L)	97	64	81
EF%	62	57	58
Additive European score	0.68%	0.8%	0.68%
CPB time (min)	86	75	85
ACC time (min)	43	30	48
Anesthesia time (min)	287	280	245
VIS	13	5	8
LOS _{ICU} (h)	49	22	18
LOV (min)	707	722	505
LOS _{hosp} (d)	18	18	22
POAF	None	None	None
AKI	None	None	None
In-hospital-mortality	None	None	None
VA-ECMO	None	None	None
Re-admission ICU	None	None	None
Re-exploration	None	None	None
PMI	None	None	None
Pulmonary complications	None	None	None
Thromboembolic complications	None	None	None
Post-operative CXR requirement	None	None	None

ACC: Aortic cross clamp; AKI: Acute kidney injury; BMI: Body mass index; CXR: Chest X-ray; CPB: Cardiopulmonary bypass; EF: Ejection fraction; LOS_{ICU}: Length of stay in intensive care unit; LOV: Length of mechanical ventilation; LOS_{hosp}: Hospital length of stay; PMI: Perioperative myocardial infarction; POAF: Post-operative atrial fibrillation; VA-ECMO: Venoarterial extracorporeal membrane oxygenation; VIS: Vasoactive inotrope score; ICU: Intensive care unit.

was a prerequisite for urgent or emergent surgical intervention[10].

Practice of routine post-operative chest radiograph

Most cardiac cardiothoracic centers practice CXR in the immediate post-operative period routinely, in absence of any clinical or laboratory indication. However, the accuracy of CXR in diagnosing pulmonary opacities in the post-operative period is limited and its accuracy in visualizing and defining etiology of pulmonary opacity is moderate[11]. Moreover, management may not be changed in response to abnormal CXR findings[12]. The risks associated with radiation exposure, manpower wastage, cost incurred, possible displacement of invasive line, and endotracheal tubes are additional concerns[13].

Transport and ICU disposition

We appealed the CTICU team to be present at the operating theatre door for receiving the patient and to minimize practitioners' transportability of a possibly contaminated PPE. Patient's transfer to the CTICU after surgery was carried out with a transport ventilator and minimal essential team comprised of a single respiratory therapist, nurse, and physician. Patel *et al*[14] emphasized the value of minimal ventilator circuit interruption, reducing practitioners' presence and unnecessary ventilator transport[14]. The same principles applied when attempting to do CXRs.

The patient's preparation before transport to ICU, by covering the patient with a plastic sheet and connecting them to a portable ventilator, was done after clamping/

de-clamping technique. Patient's escorting to the isolation room of the CTICU was done by the ICU team which comprised a physician, nurse, and respiratory therapist. Doffing of the anesthesia team was done in a pre-designated area in the operation theatre. The operation room was disinfected thereof and restricted until the following morning. The protocol for managing COVID-19 positive patients was followed by the anesthesia team.

The safety of patients transported to and from the theatres needs to be customized for each hospital, considering the basic principles of minimizing exposure and maximizing communication[15]. We have transferred COVID-19 positive patients to a COVID ICU unit enclosing negative-pressure rooms with additional high-efficiency particulate air filters. We have also taken into account early possible surgical complications such as arrhythmias, myocardial injury, acute renal injury, and the respiratory complications[16,17]. None of our three patients showed early cardiac or respiratory complications and all were able to be transferred from ICU after a median of 24 h after surgery.

CONCLUSION

While the pandemic adversely has hit the health systems worldwide, cardiac surgical patients who concomitantly contracted COVID-19 infection may undergo a smooth post-operative course as a routine post-operative CXR may not be required.

ACKNOWLEDGEMENTS

This work would not have been possible without the kind support and help of many individuals and our organization. The authors thank all members of the Cardiothoracic surgery department, Heart Hospital, of Hamad Medical Corporation, Qatar, for extensive work during this hard time and for providing the required data. The authors also thank the members of the medical research department of Hamad Medical Corporation for their support throughout this project.

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