**Name of Journal:** *World Journal of Virology*

**Manuscript NO:** 61925

**Manuscript Type:** CASE REPORT

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

Omar AS *et al*. CXR for cardiac surgical patients with COVID-19

Amr Salah Omar, Bassam Shoman, Suraj Sudarsanan, Yasser Shouman

**Amr Salah Omar, Bassam Shoman, Suraj Sudarsanan, Yasser Shouman,** Department of Cardiothoracic Surgery, Heart Hospital, Hamad Medical Corporation, Doha 3050, DA, Qatar

**Amr Salah Omar,** Department of Critical Care Medicine, Beni Suef University, Beni Suef 3050, DA, Qatar

**Amr Salah Omar,** Department of Medicine, Weill Cornell Medical College, Doha 3050, DA, Qatar

**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, HE data collection; Shouman Y performed the critical revision and cases review; all authors read and approved the final manuscript.

**Supported by** Hamad Medical Corporation.

**Corresponding author: Amr Salah Omar, MBChB, MSc, PhD, Professor,** Department of Cardiothoracic Surgery, Heart Hospital, Hamad Medical Corporation, Alryan road, Doha 3050, DA, Qatar. a\_s\_omar@yahoo.com

**Received:** January 6, 2021

**Revised:** February 3, 2021

**Accepted:** March 31, 2021

**Published online:**

**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.

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

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; In press

**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 **r**outine chest radiology may not be required for post-operative care in COVOD-19 patients undergoing cardiac surgery. This may reduce overall costs and radiographer’s unnecessary exposure.

**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 tooptimize 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 (SaO2 < 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 used 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 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.

**REFERENCES**

1 **Wang D**, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B, Xiang H, Cheng Z, Xiong Y, Zhao Y, Li Y, Wang X, Peng Z. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA* 2020; **323**: 1061-1069 [PMID: 32031570 DOI: 10.1001/jama.2020.1585]

2 **Luo H**, Tang QL, Shang YX, Liang SB, Yang M, Robinson N, Liu JP. Can Chinese Medicine Be Used for Prevention of Corona Virus Disease 2019 (COVID-19)? A Review of Historical Classics, Research Evidence and Current Prevention Programs. *Chin J Integr Med* 2020; **26**: 243-250 [PMID: 32065348 DOI: 10.1007/s11655-020-3192-6]

3 **Diaz A**, Sarac BA, Schoenbrunner AR, Janis JE, Pawlik TM. Elective surgery in the time of COVID-19. *Am J Surg* 2020; **219**: 900-902 [PMID: 32312477 DOI: 10.1016/j.amjsurg.2020.04.014]

4 **Del Rio C**, Malani PN. COVID-19-New Insights on a Rapidly Changing Epidemic. *JAMA* 2020; **323**: 1339-1340 [PMID: 32108857 DOI: 10.1001/jama.2020.3072]

5 **Shoman B**, Omar AS, Alkhulaifi A, Carr C, Sudarsanan S, Abouelnaga S, Ewila H. Perioperative management of COVID 19 patients undergoing coronary artery bypass surgery. *J Clin Anesth* 2020; **67**: 110037 [PMID: 32920345 DOI: 10.1016/j.jclinane.2020.110037]

6 **Spinelli A**, Pellino G. COVID-19 pandemic: perspectives on an unfolding crisis. *Br J Surg* 2020; **107**: 785-787 [PMID: 32191340 DOI: 10.1002/bjs.11627]

7 **Tolsma M**, Rijpstra TA, Rosseel PM, Scohy TV, Bentala M, Mulder PG, van der Meer NJ. Defining indications for selective chest radiography in the first 24 h after cardiac surgery. *J Thorac Cardiovasc Surg* 2015; **150**: 225-229 [PMID: 26005059 DOI: 10.1016/j.jtcvs.2015.04.026]

8 **Forouzannia SK**, Sarvi A, Sarebanhassanabadi M, Nafisi-Moghadam R. Elimination of routine chest radiographs following off-pump coronary artery bypass surgery: A randomized controlled trial study. *Adv Biomed Res* 2015; **4**: 236 [PMID: 26682202 DOI: 10.4103/2277-9175.167966]

9 **Hussain A**, Khan H, Lopez-Marco A, Roberts N, Oo A. Cardiac surgery in patients with confirmed COVID-19 infection: Early experience. *J Card Surg* 2020; **35**: 1351-1353 [PMID: 32531128 DOI: 10.1111/jocs.14657]

10 **Hillis LD**, Smith PK, Anderson JL, Bittl JA, Bridges CR, Byrne JG, Cigarroa JE, Disesa VJ, Hiratzka LF, Hutter AM Jr, Jessen ME, Keeley EC, Lahey SJ, Lange RA, London MJ, Mack MJ, Patel MR, Puskas JD, Sabik JF, Selnes O, Shahian DM, Trost JC, Winniford MD; American College of Cardiology Foundation; American Heart Association Task Force on Practice Guidelines; American Association for Thoracic Surgery; Society of Cardiovascular Anesthesiologists; Society of Thoracic Surgeons. 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Developed in collaboration with the American Association for Thoracic Surgery, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2011; **58**: e123-e210 [PMID: 22070836 DOI: 10.1016/j.jacc.2011.08.009]

11 **Rubenfeld GD**, Caldwell E, Granton J, Hudson LD, Matthay MA. Interobserver variability in applying a radiographic definition for ARDS. *Chest* 1999; **116**: 1347-1353 [PMID: 10559098 DOI: 10.1378/chest.116.5.1347]

12 **Labidi M**, Baillot R, Dionne B, Lacasse Y, Maltais F, Boulet LP. Pleural effusions following cardiac surgery: prevalence, risk factors, and clinical features. *Chest* 2009; **136**: 1604-1611 [PMID: 19581352 DOI: 10.1378/chest.09-0689]

13 **Chahine-Malus N**, Stewart T, Lapinsky SE, Marras T, Dancey D, Leung R, Mehta S. Utility of routine chest radiographs in a medical-surgical intensive care unit: a quality assurance survey. *Crit Care* 2001; **5**: 271-275 [PMID: 11737902 DOI: 10.1186/cc1045]

14 **Patel V**, Jimenez E, Cornwell L, Tran T, Paniagua D, Denktas AE, Chou A, Hankins SJ, Bozkurt B, Rosengart TK, Jneid H. Cardiac Surgery During the Coronavirus Disease 2019 Pandemic: Perioperative Considerations and Triage Recommendations. *J Am Heart Assoc* 2020; **9**: e017042 [PMID: 32418460 DOI: 10.1161/JAHA.120.017042]

15 **Centers for Medicare and Medicaid Services.** CMS Adult Elective Surgery and Procedures Recommendations: Limit all non-essential planned surgeries and procedures, including dental, until further notice. [cited 18 July 2020]. Available from: https://www.cms.gov/files/document/covid-elective-surgery-recommendations.pdf

16 **Lei S**, Jiang F, Su W, Chen C, Chen J, Mei W, Zhan LY, Jia Y, Zhang L, Liu D, Xia ZY, Xia Z. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. *EClinicalMedicine* 2020; **21**: 100331 [PMID: 32292899 DOI: 10.1016/j.eclinm.2020.100331]

17 **Driggin E**, Madhavan MV, Bikdeli B, Chuich T, Laracy J, Biondi-Zoccai G, Brown TS, Der Nigoghossian C, Zidar DA, Haythe J, Brodie D, Beckman JA, Kirtane AJ, Stone GW, Krumholz HM, Parikh SA. Cardiovascular Considerations for Patients, Health Care Workers, and Health Systems During the COVID-19 Pandemic. *J Am Coll Cardiol* 2020; **75**: 2352-2371 [PMID: 32201335 DOI: 10.1016/j.jacc.2020.03.031]

**Footnotes**

**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 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).

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/Licenses/by-nc/4.0/

**Manuscript source:** Invited manuscript

**Peer-review started:** January 6, 2021

**First decision:** January 25, 2021

**Article in press:**

**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

**P-Reviewer:** Wang XJ, El-Bendary M **S-Editor:** Fan JR **L-Editor: P-Editor:**

**Table 1 Description and outcome of the studied patients**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Case 1** | **Case 2** | **Case 3** |
| Age | 43 | 50 | 47 |
| BMI (kg/m2) | 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 |
| LOSICU (h) | 49 | 22 | 18 |
| LOV (min) | 707 | 722 | 505 |
| LOShosp (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 |
| Thromoembolic 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; LOSICU: Length of stay in intensive care unit; LOV: Length of mechanical ventilation; LOShosp: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.