Cardiac anesthesia in the time of coronavirus disease 2019: an Egyptian experience using a case series

Maged Salah, Ahmed Said

Department of Anesthesia, Critical Care and Pain Management, Cairo University Hospitals, Cairo, Egypt

Correspondence to Dr. Ahmed Said, MD, Department of Anesthesia, Critical Care and Pain Management, Cairo University Hospitals, 11765, Egypt. Tel: +201005287692; e-mail: a_s_helal@yahoo.com

Received: 10 November 2020
Revised: 30 November 2020
Accepted: 12 December 2020
Published: 02 July 2021

The Egyptian Journal of Cardiothoracic Anesthesia 2021, 15:24–28

The outbreak of coronavirus disease 2019 was first detected in Wuhan City, and from there it is become a pandemic and global health threat. In the time of pandemic, Cardiac surgery in nearly all cardiac centers all over the world was only confined to emergency cases. Dealing with a patient infected with this highly contagious disease is a great risk, and anesthesiologists are at a higher risk of becoming infected because of their close contact with infected patients, and when these patients are urgently in need for a lengthy difficult procedure, the risk will be at its maximum. The challenge of the anesthetic team while dealing with these patients is more difficult than we expected; so, the authors wanted to record their management and their experience with these patients.

Keywords:
anesthetic management, cardiac surgery, coronavirus, pandemic, infection control

Egypt J Cardiothorac Anesth 15:24–28

1687-9090

Introduction

The coronavirus disease 2019 (COVID-19) pandemic, which has taken thus far nearly 700 000 lives by the end of July 2020 [1], poses a significant challenge to health care services and societies globally. The pandemic, which started in a seafood market in Wuhan, China, has also exerted a tremendous socioeconomic toll, the consequences of which are yet to be fully seen. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the newest member of the coronavirus family and causative agent of COVID-19, is widely believed to be initially transmitted to humans from bats in Huanan wholesale seafood market [2]. A significant contributor to the difficulty of adequately managing the outbreak is the sheer volume of cases, which threatens to overwhelm the available resources (such as ventilators and ICU beds) of health care facilities [3].

In Egypt, the government started a bundle of precautionary measures on March 25, 2020 to avoid the spread of COVID, and one of these measures was declaration the state of emergency in hospitals, and so all elective procedures were postponed, and all medical efforts were directed toward facing this epidemic. However, urgent operations and emergency procedures must find their way amid the COVID-19 crisis. Dealing with COVID-19-infected patients represents a great challenge to the medical personnel, especially if their conditions require a lengthy surgical procedure, such as cardiac surgeries.

This challenge becomes more difficult to anesthesia team who have to perform a successful anesthetic management in addition to take all precautions to prevent and control infection based on the guidelines of World Health Organization [4].

Clinical data collection

Between the beginning of April to the end of June 2020, six patients were presented with cardiac problems and required urgent cardiac surgery (Table 1). All cases were either suspected or confirmed to be infected with COVID-19. The mean age was 53.1 years old (31–64 years old). In our six-patient series, five patients presented with chest pain and were diagnosed to have unstable angina, so urgent cardiac catheterization was done for each of them and revealed multivessel disease with left main coronary stenosis, so urgent coronary artery bypass grafting (CABG) operations were scheduled for them, and the sixth patient presented with infective endocarditis and was prepared for valve replacement surgery.

Four cases were confirmed to have COVID; they had positive PCR test and were isolated in hospital. The other two patients were suspected to have coronavirus, and their conditions required only home isolation.

Of the four hospitalized cases, two cases were in the ward on oxygen mask, and the other two cases were in the ICU. One of them was on high-flow oxygen nasal cannula alternating with continuous positive airway

Table 1 Preoperative patient characteristics

	Cases					
Parameters	#1	#2	#3	#4	#5	#6
Sex	Male	Male	Female	Male	Male	Male
Age	61	54	57	52	64	31
Medical history	HTN	HTN DM	HTN	HTN DM	DM	–
Preoperative ABG						
SO, %	96	97	97	94	95	97
PO_2, %	68	71	65	57	62	187
Respiratory rate	18	19	17	21	19	20
Supplemental O_2	Mask	Mask	Mask	High-flow nasal cannula	Mask	Mechanical ventilation
Preoperative temperature, °C	37.8	38.2	37.5	38.6	37.7	37.6
Lymphocytic count ($\times 10^9$l)	1.2	0.71	0.73	0.68	1.1	0.9
CT finding	Bilateral ground glass appearance	Bilateral ground glass appearance	Bilateral ground glass appearance	Bilateral ground glass appearance	Bilateral ground glass appearance	Bilateral Ground glass appearance
COVID diagnosis	Suspected	Confirmed	Confirmed	Confirmed	Suspected	Confirmed
Time of hospital stay before operation, days	Home	5	6	9	Home	14 days in ICU

ABG, arterial blood gas; COVID, coronavirus disease; CT, computed topography; DM, diabetes mellitus; HTN, hypertension.

pressure mask and had a persistent fever, and the other one was intubated and mechanically ventilated, as he was presented with disturbed conscious level, and his investigations revealed intracerebral acute hematoma with brain edema and infective endocarditis with heart failure and severe aortic regurge, severe mitral regurge, and severe tricuspid regurge, in addition to testing positive for COVID-19. This patient was admitted to ICU for 2 weeks where he was mechanically ventilated and managed medically until his conscious level was improved and then cardiac surgery was performed to replace aortic, mitral, and tricuspid valves with prosthetic valves. The patient continued treatment in the ICU for 11 days until his pulmonary condition improved and then was transferred to the ward; 3 days later, his COVID test became negative, and after another 4 days, he was discharged home after improvement of his general condition.

Preoperative assessment

Preoperatively, the key priority was to optimize chest condition with careful assessment of other systems that may be affected. Moreover, careful assessment of airway was done to know if there is suspected difficult airway as we hoped to avoid awake intubation and repeated attempts of intubation. All pulmonary investigations were done to assess the severity of pulmonary involvement, including radiograph, computed tomography, and arterial blood gas. Kidney and liver functions were carefully assessed for all patients.

Cardiac assessment

COVID-19-infected patients may have cardiac affection in addition to the original cardiac condition, and although diagnosis of myocarditis is difficult, especially in patients with acute cardiac conditions who require cardiac surgery, there are some cardiac signs that may suggest diagnosis of myocarditis owing to COVID-19, including abnormal or new changes in ECG, presence or increased troponin, and new or abnormal functional and structural changes on cardiac imaging.

The treatment protocol applied in Egypt may be problematic for cardiac patients with COVID-19 as it includes treatment with hydroxychloroquine and azithromycin (Supplementary file 1).

Until the date this article had been written, hydroxychloroquine was still considered a potential treatment for COVID-19 based on its mechanism of action, as it can prevent viral entry to cells [5–8], but it has adverse drug reactions, which may lead to severe cardiac disorders, such as QT segment prolongation, which could lead to arrhythmia, myocardial arrest, or cardiovascular death [9]. Azithromycin and macrolides in general are known to induce cardiotoxicity when used alone, and they may enhance the effect of hydroxychloroquine, which prolongs QTc interval [10–13].

Preoperative preparation

We followed the guidelines of Centre for Disease Control and Prevention and World Health

Organization [14]. All medical staff adopted third-level medical protection measures. Strategies to decrease the risk of exposure to viral particles during the procedure were applied and included the use of an N95 mask, a face shield or medical goggles, disposable protective clothing, latex gloves, and shoe covers. Patients were transferred to operating room wearing surgical masks, and for patients who were in need of high-flow oxygen during transfer, we used least possible oxygen flow which maintained oxygenation and avoided aerosol generation.

Intraoperative management

During induction of anesthesia, tracheal intubation was performed by a senior anesthetist who was present alone with his assistant in the operating room, whereas the rest of anesthesia team and surgical staff were allowed to enter the operating room only after endotracheal intubation and securing all the connections with adhesive tapes.

Fentanyl was given in small incremental doses to minimize its coughing effect, and a full dose of muscle relaxant was given at one time to ensure muscle paralysis before intubation.

Before insertion of endotracheal tube, mask ventilation was done by two-handed grip to seal the face mask, and after intubation, the positive pressure ventilation was started after inflation of the cuff of the endotracheal tube. Moreover, we inserted bacterial viral filter to the expiratory limb of the breathing circuit apart from the heat and moisture exchanger. Breathing circuit disconnection was managed by fixing all connections, and if surgeon asked to stop ventilation that allowed to just switching the ventilator to stand by position, and if at any time disconnection happened, the endotracheal tube was immediately clamped.

Ventilation was maintained with lung-protective mechanical ventilation strategies by maintaining tidal volumes of 5–6 ml/kg. Moreover, we increased respiratory rate to maintain minute ventilation and to keep peak airway pressure below 30 mmHg with peep 5–10 cmH_2O.

In these case series, we decided to maintain anesthesia by volatile anesthetics especially sevoflurane before and after cardiopulmonary bypass and use total intravenous anesthesia (TIVA) by propofol for maintenance of anesthesia during the cardiopulmonary bypass period.

In four cases, CABGs were done on pump and the fifth was off pump. The response of patients to anticoagulation was variable, and in three patients, we gave additional doses of heparin to achieve activated clotting time more than 450 s, and for the patient who underwent surgery to replace mitral, aortic, and tricuspid valves, he received two units of fresh frozen plasma in addition to the extra dose of heparin to achieve activated clotting time 456 s.

Two cases of on-pump CABG experienced difficulty in weaning from cardiopulmonary bypass, as they experienced different types of arrhythmias, which required multiple DC shocks, and in one case, intravenous amiodarone started intraoperatively and was continued in the ICU.

Results

On follow-up, one case experienced high drainage that required reoperation, and chest exploration (Table 2). The patient was transferred to the OR on a portable ventilator. All safety measures were applied by the surgical team during assessment and operation, and the patient was transferred again to ICU postoperative.

Table 2 Postoperative characters of the patients

Parameters	Cases					
	#1	#2	#3	#4	#5	#6
Mode of ventilation	SIMV	SIMV	SIMV	SIMV	SIMV	SIMV
Postoperative ventilation, days	1	2	2	3	1	6
Postextubating SO_2%	95–97	94–96	92–95	90–94	96–97	93–95
Need of postextubation noninvasive ventilation	No	No	No	Yes (CPAP mask for 1 day)	No	Yes (CPAP mask for 2 days)
ICU, days	3	3	4	6	2	11
Postoperative drainage, ml	600	750	1450	850	200	450
Reopening for chest exploration	No	No	Yes	No	No	NO
Postoperative hospital stay, days	8	10	11	14	7	18

CPAP, continuous positive airway pressure; SIMV, synchronized intermittent mandatory ventilation.

The range of ICU stay was from 3 to 11 days. The mean days of ventilation were 2.5 days. Moreover, postoperative hospital stay was in the range from 8 to 18 days. All patients were discharged after pulmonary and cardiac improvement, and the PCR test results for COVID-19 were negative.

PCR results were positive in four patients preoperatively and repeated once in three patients after discharge from ICU, on the 5th, 8th, and 10th days of their hospital stay, and in the last patient who had infective endocarditis, PCR test was done twice; the first result was positive and done on his 8th day in the ICU, and the second test was done 6 days later and turned negative.

Discussion

Cardiac surgery in the time of COVID-19 outbreak in nearly all cardiac centers all over the world was only confined to emergency cases. A total of 60 cardiac centers in America, Europe, and Asia included in a survey demonstrated that there was a great reduction in number of cardiac surgeries with almost no elective cases [15].

As the ICUs in cardiac centers are opened for COVID-infected patients, and the resources were directed to these patients, elective cases were postponed as long as possible.

In addition, the fear from perioperative COVID-19 infection of elective cardiac patients has a great concern, as reported by a study performed in Wuhan, China, which found that nearly all elective patients who underwent noncardiac surgeries became infected with COVID-19, with 20% mortality [16].

The decision making in cardiac patients with suspected or confirmed COVID infection necessitating surgical management requires judging the risk of postponing the surgery and avoiding exposure to coronavirus and the risk of performing the surgery and taking all the precautions to minimize the risk of infection.

In our cases, we had to perform the surgeries and take the risk of dealing with new, totally undefined virus, with unknown repercussions in the consequences of intraoperative and postoperative course of the patients.

Dealing with a COVID-19-positive patient is a great risk, and when these patients are urgently in need for a lengthy difficult procedure, the risk will be at its maximum. The challenge of the anesthetic team while dealing with these patients is more difficult than we expected; so, the authors wanted to record their management and their experience with these patients. The infectious nature of coronavirus made every step in the anesthetic management done with great caution to prevent aerosol generation and avoid contact with any human secretions as well [17,18], especially with the airway management and tracheal intubation, as these are associated with the greatest risk of infection [19]. Placement of arterial line and central line for hemodynamic monitoring was difficult to some extent owing to wearing of personal protective equipment (PPE) and other protective measures. The use of transesophageal echocardiogram was minimized to be inserted only in highly indicated cases, as insertion of probe was known to be one of the aerosol-generating procedures [20,21].

Choice of anesthetic technique was discussed either to maintain anesthesia with TIVA or inhalational anesthesia. TIVA with propofol has many advantages, as it is known that propofol can increase the innate immunity through activation of natural killer cells and cytotoxic T cell, and these are the first line of defense against COVID-19, which attacks the innate immunity. In addition, propofol has a role as an antioxidant and free radical scavenger, so can reduce ischemic and reperfusion injury to vital organs [22,23]. On the contrary, many studies have reported that the use of volatile anesthetics during cardiac surgery, and especially during CABG, has cardiac protection effect and reduces the risk of perioperative myocardial infarction, myocardial dysfunction, and death [24–27].

With such lengthy procedures, having to wear full PPE was a burden by itself. We used adhesive tape to seal the connection between the protective goggles and mask and the PPE cap.

The reported hemostatic changes in COVID-19-infected patients and the high mortality in patients who fulfilled the criteria of the International Society of Thrombosis and Haemostasias (ISTH) for DIC [28] made the COVID-19-infected patients more susceptible to thrombotic effects, which may be owing to cytokine storm precipitated by corona virus. Moreover, it is suggested that there is a correlation with elevated levels of acute-phase reactants, such as fibrinogen and C-reactive protein, and the associated hypercoagulability seen with COVID-infected patients [29–32]. So, daily monitoring of D-dimer, fibrin degradation products, and troponin was done. Moreover, the postoperative management in these patients gave special attention to

anticoagulation, so anticoagulants were started as early as possible in the ICU, even in the presence of relatively high postoperative drainage in the form of low-molecular-weight heparin.

In our patients, the levels of D-dimer increased significantly in two patients, starting from the third and fourth day postoperatively and reached levels more than 2000 ng/ml, so the dose of low-molecular-weight heparin increased, and after they started enteral feeding, they received two types of antiplatelet (aspirin and clopidogrel), in addition to warfarin according to the hospital ICU protocol.

Conclusion

In conclusion, successful anesthetic management of cardiac surgery emergencies in COVID-19-positive patients requires implementation of a special strategy, which includes infection control and prevention in addition to the management of the cardiac surgery. The authors like to record their experience that may be useful for other colleagues.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 European Centre for Disease Prevention and Control. Situation update worldwide. March 6, 2020 08:00.

2 Ji W, Wang W, Zhao X, Zai J, Li X. Cross-species transmission of the newly identified coronavirus 2019-nCoV. J Med Virol 2020; 92:433–440.

3 Sun P, Lu X, Xu C, Sun W, Pan B. Understanding of COVID-19 based on current evidence. J Med Virol 2020; 92:548–551.

4 World Health Organization (WHO). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19). World Health Organ 2020; 2019:1–7.

5 Colson P, Rolain J-M, Lagier J-C, Brouqui P, Raoult D. Chloroquine and hydroxychloroquine as available weapons to fight COVID-19. Int J Antimicrob Agents 2020; 55:105932.

6 Savarino A, Boelaert JR, Cassone A, Majori G, Cauda R. Effects of chloroquine on viral infections: an old drug against today's diseases? Lancet Infect Dis 2003; 3:722–727.

7 Fedson DS. Confronting an influenza pandemic with inexpensive generic agents: can it be done? Lancet Infect Dis 2008; 8:571–576.

8 Vigerust DJ, Shepherd VL. Virus glycosylation: role in virulence and immune interactions. Trends Microbiol 2007; 15:211–218.

9 FDA. Plaquenil hydroxychloroquine sulfate drug safety. FDA, Bethseda: 2006.

10 Guo D, Cai Y, Chai D, Liang B, Bai N, Wang R. The cardiotoxicity of macrolides: a systematic review. Pharmazie 2010; 65:631–640.

11 Ray WA, Murray KT, Hall K, Arbogast PG, Stein CM. Azithromycin and the risk of cardiovascular death. N Engl J Med 2012; 366:1881–1890.

12 Fossa AA, Wisialowski T, Duncan JN, Deng S, Dunne M. Azithromycin/chloroquine combination does not increase cardiac instability despite an increase in monophasic action potential duration in the anesthetized guinea pig. Am J Trop Med Hyg 2007; 77:929–938.

13 Lu ZK, Yuan J, Li M, Sutton SS, Rao GA, Jacob S, Bennett CL. Cardiac risks associated with antibiotics: azithromycin and levofloxacin. Expert Opin Drug Saf 2015; 14:295–303.

14 Centers for Disease Control and Prevention. What healthcare personnel should know about caring for patients with confirmed or possible 2019-nCoV infection: Centers for Disease Control and Prevention 2020. https://www.cdc.gov/ coronavirus/2019-ncov/hcp/caring-for-patients.html. [Accessed on 16/02/2020].

15 Gaudino M, Chikwe J, Hameed I, Robinson NB, Fremes SE, Ruel M. Response of cardiac surgery units to COVID-19: an internationally-based quantitative survey. Circulation. Availabe at: https://doi.org/10.1161/CIRCULATIONAHA.120.047865. [Accessed April 29, 2020].

16 Lei S, Jiang F, Su W, Chen C, Chen J, Mei W, *et al.* Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. E Clin Med 2020; 21:100331.

17 Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, *et al.* Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med 2020; 382:1199–1207.

18 Lu C, Liu X, Jia Z. 2019-nCoV transmission through the ocular surface must not be ignored. Lancet 2020; 6736:30313.

19 van Doremalen N, Morris DH, Holbrook MG, Gamble A, Williamson BN, Tamin A, *et al.* Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. N Engl J Med 2020; 382:1564–1567.

20 Augoustides JR. Perioperative echocardiography: key considerations during the coronavirus pandemic. J Cardiothorac Vasc Anesth 2020; 34:1416–1418.

21 American Society of Echocardiography. Statement on protection of patients and echocardiography service providers during the 2019 novel coronavirus outbreak. Available at: https://www.asecho.org/wp-content/uploads/2020/03/ ASE-COVID-Statement-FINAL-1.pdf. [Accessed April 4, 2020].

22 Marik PE. Propofol: an immunomodulating agent. Pharmacotherapy 2005; 25: 28S–33S.

23 Murphy PG, Myers DS, Davies MJ, Webster NR, Jones JG. The antioxidant potential of propofol (2,6-diisopropylphenol). Br J Anaesth 1992; 68: 13–18.

24 De Hert S, Vlasselaers D, Barbé R, Ory J-P, Dekegel D, Donnadonni R, *et al.* A comparison of volatile and non volatile agents for cardioprotection during on-pump coronary surgery. Anaesthesia 2009; 64:953–960.

25 Likhvantsev VV, Landoni G, Levikov DI, Grebenchikov OA, Skripkin YV, Cherpakov RA. Sevoflurane versus total intravenous anesthesia for isolated coronary artery bypass surgery with cardiopulmonary bypass: a randomized trial. J Cardiothorac Vasc Anesth 2016; 30:1221–1227.

26 Uhlig C, Bluth T, Schwarz K, Deckert S, Heinrich L, De Hert S, *et al.* Effects of volatile anesthetics on mortality and postoperative pulmonary and other complications in patients undergoing surgery: a systematic review and meta-analysis. Anesthesiology 2016; 124:1230–1245.

27 Landoni G, Greco T, Biondi-Zoccai G, Nigro Neto C, Febres D, Pintaudi M, *et al.* Anaesthetic drugs and survival: a Bayesian network meta-analysis of randomized trials in cardiac surgery. Br J Anaesth 2013; 111:886–896.

28 Levi M, Toh CH, Thachil J, Watson HG. Guidelines for the diagnosis and management of disseminated intravascular coagulation. British Committee for Standards in Haematology. Br J Haematol 2009; 145:24–33.

29 Mehta P, McAuley DF, Brown M, Sanchez E, Tattersall RS, Manson JJ, *et al.* COVID19: consider cytokine storm syndromes and immunosuppression. Lancet 2020; 395:1033–1034.

30 Giamarellos-Bourboulis EJ, Netea MG, Rovina N, Akinosoglou K, Antoniadou A, Antonakos N, *et al.* Complex immune dysregulation in COVID-19 patients with severe respiratory failure. Cell Host Microbe 2020; 27:992–1000.e3.

31 Maier CL, Truong AD, Auld SC, Polly DM, Tanksley CL, Duncan A. COVID19-associated hyperviscosity: a link between inflammation and thrombophilia? Lancet 2020; 395: 1758–1759.

32 Liu F, Li L, Xu M, Wu J, Luo D, Zhu Y, *et al.* Prognostic value of interleukin-6, C-reactive protein, and procalcitonin in patients with COVID-19. J Clin Virol 2020; 127:104370.