International study on impact of COVID-19 on cardiac and thoracic aortic aneurysm surgery

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Abstract

Background: The coronavirus disease-2019 (COVID-19) pandemic gripped every nation’s health care system and provisions on all levels. In cardiac and aortic surgery, as it is with most specialties, elective surgeries were halted.

Aims of the study: We captured reflections, contingencies, and current practices across of high-volume centers in cardiac and aortic surgery globally. We also aimed this study to assess decision on prioritization of the surgical patients, the need for personal protection equipment, and the choice of preoperative investigations in current dynamic and fluid climate.

Methods: A validated web-based questionnaire was constructed and was circulated to the international surgeons amongst high volume cardiac and aortic surgery centers. Their intrinsic feedback on decision making, the impact of the lockdown, and perspectives for the future ahead of us all were noted. A mixed-method approach was constructed. Qualitative data analysis was introduced to signify the impact globally.

Results: Overall, 23 centers from 18 countries participated in this international study. About 91.7% of the respondents stopped operating on elective patients during the pandemic. The majority of the surgeons agreed that acute aortic dissection (87.1%) should be operated as an emergency procedure and stable triple vessel disease (87.1%) to be considered as an elective procedure. Three-fifth (60%) of the respondents relied on computerized tomography chest as a preoperative screening modality.

Conclusion: In the present climate where there is a paucity of evidence, this will give an interim consensus for the cardiac surgeons. With the increase in the cumulative number of patients with COVID-19, careful utilization of the resources regarding hospital beds and manpower is of paramount importance.

Key words: aorta and great vessels, cardia usurfection, cardiovascular research, coronary artery disease, COVID-19, thoracic surgery
1 | INTRODUCTION

The first cases of most probable patients with coronavirus disease-2019 (COVID-19), with the presentation of pneumonia with unknown cause, were reported on 31 December 2019, and Chinese authorities announced the identification of a new type of coronavirus on 7 January 2020. With the increasing trend of death among infected people, WHO declared a “Global Emergency” followed by “Global Pandemic” of new coronavirus, now called COVID-19. Currently, the number of infected cases is still on the rise with more than 10 million people who have been diagnosed with COVID-19 and over half a million losing their lives spanning across 215 countries around the world.

This pandemic added additional strain on international health care sectors. To focus the resources available at every hospital and institution, and in the interest of saving lives of affected patient populations, and also to prevent unnecessary postponing care of patients with cardiovascular disease (CVD), new stringent guidance which of course varied between hospitals and countries were issued. However, the preponderance has highlighted the need to reduce elective procedures’ volume, and cardiovascular surgical procedures were no exception. Therefore, in response to the pandemic, cardiac surgery departments have dramatically curtailed their activities, limiting this to urgent and emergent cases, and life-threatening scenarios. We wanted to assess operational management of affected international cardiac surgery units, their conduct of decision process on how this imposed government policy impacted the arrangement of emergency cases, and lack of wide scrutinized practices. We dwelled on deriving facts to operate on individual emergency cases the aortic ones and the context of numerous medical and logistic considerations. This reflects the consideration and disparities between recommendations; the way cardiac surgery practice was influenced by clinical judgments rather than relying solely on guidelines.

2 | METHODS

The method of this study had to be adaptable to the dynamic change of the virulence of the virus as anticipated internationally. Primarily, this study was centered on mixed-method approach entailing a qualitative assessment of surgeons’ responses while quantitatively recording a binary element. This allowed a wider appraisal of the international responses and different opinions on clinical decision making from pooled practices. The questionnaire incorporated a framework of quality decision making allowing diversity and heterogeneity of different patients’ population requiring cardiac surgery during the COVID-19 pandemic. It was predetermined, that absolute majority will be attributed when more than 60% agree upon and an equivocal majority when it was 40% to 60%. To investigate the variations of strategies in response to this pandemic amongst cardiac surgery departments across the countries, we prepared a questionnaire that collated responses from a variety of invited cardiac surgery institutions to series of questions about temporary shutdowns and their activities. A web-based questionnaire was sent to all participating surgeons at high volume centers from 10 May 2020 and we predetermined to close the study within 10 days after. Moreover, participants were asked to declare their opinions regarding additional protective measures and the way they prioritize some diagnoses into different categories during that period. The objectives were to assess operational management of affected international cardiac surgery units, their conduct of decision process on how this imposed government policy impacted the arrangement of emergency cases, and lack of wide scrutinized practices. We dwelled on deriving facts to operate on individual emergency cases the aortic ones and the context of numerous medical and logistic considerations. This reflects the consideration and disparities between recommendations; the way cardiac surgery practice was influenced by clinical judgments rather than relying solely on guidelines.

(I) Inclusion and exclusion criteria: There were a set of stringent inclusion and exclusion criteria developed by the authors collectively. The inclusion overtly entails appropriate volume per center and surgeon, mixed cardiac and aortic experience, practices, and avoidance of district hospitals. It also factored the geographical index and variation to optimize capturing data and experience from a wide array of countries to reflect on the extent and impact of the pandemic on cardiac surgery front. The exclusion criteria focused mainly on disqualifying characteristics that the authors strictly adhered to avoid cognitive and selection biases.

(II) Statistical analysis: All the data were collected from Google Forms on an excel sheet and were analyzed using SPSS (Statistical Package for Social Science) version 14.

(III) Population characteristics: The population covered by this study is without any doubt mixed and heterogeneous. It is clearly inapplicable to the construct of this study to have used a homogenous model with the linear transmission. The equation for the final size of a pandemic for an arbitrary initial distribution of susceptibility is found. The implications of population heterogeneity are relevant to this study, however, the stride of this study focused on surgeon practices and decision making rather a on their corresponding population cohort.

(IV) Ethics: There was no intervention in this study. The objectives and method of the study were explained to participating surgeons before approving to take part. Data collated from individual surgeon did not include patients. All data obtained were from surgeon’s practice and clinical decision amid the pandemic. There was no extra burden and no extra charge for them. All data was sent by a secured code and anonymously.
3 | RESULTS

The questionnaire and the response have been presented in Table 1. Overall, 23 centers from 18 countries participated in this international study. The participants were distributed geographically as demonstrated in Figure 1. Amongst the participants, three consultants responded to the questionnaire from USA and Italy, two from UK, and one response from each following country was recorded: Algeria, Bangladesh, Belgium, Canada, France, Germany, Greece, India, Iran, Japan, Kuwait, Lithuania, Oman, Switzerland, and Turkey. The majority of cardiac centers invited perform high volume bulk of cases denoted demonstrated by the frequency distribution of responders’ as to as more than 250 (95.8%). The majority of participants have an overall cardiac surgical experience of 15 to 20 years (37.5%), and more than 25 years of experience recorded at 25% of all participants.

As estimated by the scale of the pandemic, 91.7% of participants ceased elective operations during the lockdown imposed by locals’ governors. About 69.5% of respondents declared stated that their practice was halted before 16 March 2020.

The analysis also demonstrated that whilst the majority of centers (58.3%) have not resumed their elective practice at the time of ending the analysis, 36.4% estimated that their operational managers will resume a certain extent of cardiac-surgical elective practice by 04th of May. However, 25% of the group estimated resumption of elective capacity by 1st June which is a most likely reflection of the ease down of the lockdown. This is important and yielding to show how the situation globally is fluid and uncertain.

However, apart from Canada, surgeons in all countries deferred elective cardiac surgery procedures. Oman was the first country to halt elective procedures which as indicated was on 4 January 2020. On the contrary, Japan was the last one to stop elective procedures which were indicated to us on 12 April 2020. Majority of timing to halt elective surgery in each country clearly correlated to their corresponding governments’ timing of lockdown or declaring emergency status in their state or country. Despite the pattern, as demonstrated Turkey did not stop performing elective surgery.

Regarding resuming elective operation, the majority of respondents instigated that they would resume elective operations toward last week of June. Out of the overall sample, 12 surgeons (52.1%) considered that normal activity will return back within 6 months after pandemic flattens. Surprisingly, nine (39.1%) of them assumed that this interval will be at least 1 year, while two (8.8%) of respondents considered this will extend to 3 years.

3.1 | Consensus on surgery

To achieve a better understanding of the surgeons’ practice during the pandemic and the difference of cardiac surgery priorities between pre and post COVID-19 era, we asked them regarding how they prioritize some specific surgeries (Figure 2).

Absolute majority was opined on the following:

1. Acute aortic dissection with (87.1%) or without (87.1%) mal-perfusion as an emergent procedure.
2. Stable 3 vessel coronary artery disease (3VCAD) (87.1%) and paravalvular leaks without pulmonary edema (69.9%) to be performed as elective surgery.
3. Left main coronary artery disease without chest pain (87.1%) as an urgent procedure.
4. Ascending aorta aneurysm more than 45 mm in bicuspid aortic valve (BAV) (78.5%) and connective tissue disease (CTD) (78.5%) to be performed as elective procedures.

Equivocal majority was opined in the following:

1. Ascending aorta aneurysm more than 55 mm in the non-BAV or non-CTD to be performed as urgent (43%)/elective (53.7%).
2. 3VCAD with rest pain (43%/48.4%) and paravalvular leak with pulmonary edema (39.8%/47.3%) to be operated with 48 hours either as emergency or urgent.

3.2 | Consensus on investigation

Regarding patients’ screening modality majority of the surgeons relied on computerized tomography CT chest (60%) as a screening modality for COVID-19 as compared with the other mode of investigation. The respondents (13.1%) from USA and Italy stated that they will not perform any additional investigation in patients with COVID-19. In COVID-19-negative patients, surgeons would operate as pre-COVID era or would take regular universal precautions. Chest CT scan and a nasopharyngeal swab test for polymerase chain reaction (PCR) were the most frequent response (12 respondents) to the question that what protocol should be considered in patients with COVID-19 needs cardiac surgery. Pulmonary function test, inflammatory markers (eg, C-reactive protein), and serology test were other responses.

3.3 | Person protection equipment

All surgeons undertook the survey agreed to utilize maximum personal protection equipment (PPE) in every patient without regard to patient’s COVID-19 status. Moreover, three of the respondents highlighted the matter of reducing number of operating room staff to a minimum level. Except three respondents, all other surgeons (86.9% of participants) will use level III personal protection equipment to operate on patients with COVID-19. Three surgeons (13.1%) responded that they would isolate the patients with COVID-19 having all precautions.
TABLE 1  The questionnaire and the response has been tabulated

1  Country
2  How many years have you been in practice as a cardiac surgeon?
3  How many cardiac cases does your center perform per year?
   1 to 3: Figure 1
4  Did you stop elective surgery due to COVID-19?
   Yes  23 (92%)
   No  2 (8%)
5  If yes, When did you stop the elective surgery due to COVID-19? (23 response)
   Jan 2020  1
   Mar 2020  20
   Apr 2020  1
   May 2020  1
6  Have you resumed your routine elective cardiac surgeries?
   Yes  15 (60%)
   No  10 (40%)
7  If “Yes,” when did you resume your elective surgery? (11 response)
   Mar 2020  1
   Apr 2020  2
   May 2020  8
8  If “No,” when do you expect to restart elective surgery?
   2nd week of May 2020  1 (4.3%)
   3rd week of May 2020  1 (4.3%)
   Last week of May 2020  2 (8.6%)
   1st week of June 2020  6 (25.85)
   2nd week of June 2020  1 (4.3%)
   3rd week of June 2020  1 (4.3%)
   4th week of June 2020  1 (4.3%)
   July or beyond  1 (4.3%)
   Not sure  9 (39.8%)
9  Did you perform emergency/urgent/salvage surgeries after Feb 2020?
   Yes  24 (96%)
   No  1 (4%)
10 If you have performed emergency/urgent/salvage surgeries after Feb 2020, please select the options below (LMSD, 3VD, BAV, and CTS)
   <10  11-20  21-30  31-40  41-50  51-60  >60
   Acute aortic dissection with malperfusion  18  1 - - - - 1
   Acute aortic dissection without malperfusion  19  2 - - 1 - -
   Ascending aortic aneurysm >5.5 cm in non-BAV, non-CTS cohort  21  2 - - - 1 -
   Ascending aortic aneurysm >4.5 cm in BAV cohort  14 - - - 1 - -
   Ascending aortic aneurysm >4.5 cm in CTD cohort  13 - - 1 - - -
   3VD with chest pain at rest  14  6 2 1 - - -
   Significant LMSD without chest pain  14  6 3 - - - -
   Stable 3VD  9  2 5 1 - - -
   Paravalvular leak without pulmonary edema  9  1 - 1 - - -
   Paravalvular leak with pulmonary edema  11 - - - 1 - -
11  In the current climate how would you prioritize the following cases? (LMSD, 3VD, BAV, and CTS)
   Figure 2
12  When do expect cardiac surgery practice to go back to “pre-COVID-19 pandemic period”?
   Yes  50 (31.3%)
   No  110 (68.8%)

Abbreviations: BAV, bicuspid aortic valve; COVID-19, coronavirus disease-2019; CTS, connective tissue disorder; LMSD, left main stem disease; 3VD, triple vessel coronary artery disease.
FIGURE 1  The geographic distribution of the participants, years of clinical experience, and the number of surgeries performed per year is represented in the figure.

FIGURE 2  Prioritization of the surgery: The percentage of response as emergent/urgent/salvage/elective have been presented. The percentage of “Absolute majority” have been represented in white box.
COVID-19 pandemic has permeated every aspect of the health care system, including resource utilization, diagnostic interventions, treatment options, and prioritizations. A paucity of guidelines, recommendations, and commentaries exists making the management of patients difficult. The statistics and international databases show that the mortality and morbidity of patients with COVID-19 are not the same in even neighboring cities, which shows the unpredictable nature of the disease. With the present evidence, it is futile to provide a single strategy or guideline across the globe. With the changing climate every day and the evolving evidence, it is not and exaggeration to say, by the time a guideline is formed with the available literature, a new one may emerge. The present article is focusing on several aspects of the cardiovascular surgery field endeavoring the best-suited solutions in this period.

Looking briefly at guidelines and reports from centers across the world can demonstrate us that the majority of them are centered around reducing the volume of elective procedures to relocate resources to provide optimum care to patients affected by COVID-19. The question which raises eyebrows is “what are the consequences of temporary elective procedures being shut down during the COVID-19 era?” This will two pose two problems (a) risk of patients waiting for surgery and (b) crowding of all the backlog patients when the “gates” are opened. All the centers which participated in our survey, perform a minimum 250 patients/year, which is ~20 cases per month. Except for 2 to 3 countries all other have not performed elective surgery from March 2020. The numbers of emergency surgeries performed in these centers are less than 10. This works out there is a backlog of a minimum 30 patients/center. When the data are extrapolated to a wider base, the numbers of backlog cases are exponential high. With the pandemic still extending, reservation of intensive care unit (ICU) beds continues further diminishing the number of surgical procedures. Further data on the outcome of patients who are waiting for elective surgery are yet to evolve. In a study by Salenger et al, cardiac surgery volume fell to 54% of baseline after restrictions were implemented and one to 8 months are predicted to resolve the backlog from shut down. These figures are different in relation with the number of affected patients and health care infrastructure for a resumption of routine cardiac surgeries. Lack of data from various countries or even biased data confer a much bigger problem in evaluating the situation and, designing trustworthy recommendations.

Interestingly, the European Society of Cardiology guidelines suggests operating aortic aneurysm in patients with CTD when there are more than 50 mm and more than 55 mm in patients with non-BAV/non-CTD. More than 50% of respondents consider aneurysm more than 55 mm in non-BAV or non-CTD as elective surgery. Turkey did not stop elective surgery during the pandemic. Paradoxically, the rapid increase of the confirmed cases in Turkey did not overburden their respective public health care system and the preliminary case-fatality rate remained lower compared too many European counterparts. Discussions mainly attributed these to the country’s relatively young population and high number of available intensive care units.

4.1 | Timing for reopening of elective surgery

If it advisable to start elective surgery when there is a sustained decrease in the rate of new patients with COVID-19 in a geographic location for a minimum of 2 weeks. The resumption should be authorized by the appropriate municipal, county, and state health authorities. The surgeon should consider other facilities including the ICU beds, PPE, ventilators, and trained staff before starting to perform elective surgery. Apart from this, the wellbeing of his team and commute of team members between home and hospital must consider.

4.2 | Prioritizing the surgical procedures

Following should be considered when prioritizing the patients for surgery

1. List of previously canceled and postponed cases.
2. Strategy for increasing “OR/procedural time” availability.
3. Availability of ICU beds and health care workers (HCW).
4. Issues associated with increased OR/procedural volume.

We would be encountering three subset of patients: COVID-positive patients, COVID survivors, and COVID-negative patients

1. COVID-positive patients: A recent analysis of 1128 COVID-positive patients who underwent surgery, the 30-day mortality was 23.8% and pulmonary complications occurred in more than half of these patients (51.2%). Following cardiac surgery, patients are more prone for respiratory complications which adds to the existing morbidity and mortality
2. COVID survivors: This is a subset of patients whom we will be encountering sooner or later. Studies have shown myocardial damage ranging up to 27% in patients with COVID-19. The aftermaths of this myocardial damage and their implication in cardiac surgery needs further clinical evaluation.
3. COVID-negative patients: These patients can be considered as a patient operated before COVID era.

4.3 | “Waiting period” before surgery

Several studies and risk stratification score have been provided earlier for ideal waiting period for cardiac surgery. Most of these scores include coronary artery bypass graft and/or Aortic valve replacement. The model proposed by Rexius et al is easy to use. It takes variables like angina, left main stem disease, aortic valve disease, left ventricular function, and gender into considerations. The scores are added, and the severity is graded as high, intermediate,
and low score indicating the need for surgery within 2 weeks, 12 weeks, and 6 months, respectively.

4.4 | Investigations

The surgeons should use the available facility to test and protect all the team members and the patients. There is no guideline at present to dictate the frequency and timing of testing preoperative for surgical patients. The testing policy should include accuracy and timing consideration to provide useful information. Though few authorities do not recommend routine COVID testing for patients, the factor which drive the surgeons to perform COVID testing preoperatively include (a) high transmission rate of the virus, (b) high mortality when COVID is associated with CVD, and (c) cardiovascular team works in close proximity, enabling the easy spread of the disease. Real time-PCR has a high specificity with a low sensitivity (~70%) while CT chest has a high sensitivity with allow sensitivity. Though evidence still lack, the authors prefer a combination of both in preoperative testing.

4.5 | Personal protection equipment

Guidelines for optimum surgeon protection before, during, and after operation have been given the American college of surgeons and National Institute for Health care Excellence. The importance of PPE, N95, and hand hygiene needs to be emphasized at this juncture. The acceptance of a combination of N95 and a surgical mask (N95-SM) for prolonged periods is subjected to many variables and varies between different subjects. Literature has shown a few people have a better tolerable level than others, emphasizing the large variable in individual responses to the respirators. The tolerability of respirators has been attributed to overall discomfort, diminished vision/vocal/auditory sense, raised humidity, headaches, facial pressure, skin irritation, excessive fatigue, malodorousness, anxiety, and claustrophobia. Yet the tolerability of respirators among surgeons who wear respiratory protection for long durations is not been well documented.

In a survey of over 2000 HCW during the severe acute respiratory syndrome outbreak, 70.2% felt that wearing mask is the most bothersome precaution and 92.9% of the felt physical discomfort as the major issues with masks. There was a communication difficulty in nearly half of the respondents (47%).

The combination of N95-SM enhances the respiratory resistance leading to increased respiratory exertion, heart rate, thermal stress, and subjective discomfort. The decrease in minute volume and shortened expiratory time may result in lowered oxygen level and increased CO2 retention. The N95-SM combination would stymie the diffusion of exhaled CO2, a portion of which is retained in the potential space between both, generating a second repository for exhaled CO2. The increased breathing resistance leads to hypoxemia and hypercarbia and is correlated with adverse effects as impaired mental performance and increased headaches in HCW. One of the most common reasons cited by the user for removing respirators is thermal discomfort.

Raised perioral temperature is uncomfortable which may lead to reactions like claustrophobia or development of facial acne. The N95-SM combination may dampen the sound which impairs the surgeons’ verbal communication ability attenuating sound transmission, decreasing sound volume and reducing intelligibility.

5 | LIMITATIONS

We understand that the situation with COVID-19 is evolving on a daily basis. It is possible that some of the recommendations may need to be changed or even reversed as further evidence emerges. It is also plausible that surgeons, infectious-disease physicians, nurses, and hospital administrators may disagree with some of the recommendations. Furthermore, each region and hospital system may have specific limitations that may render some of these recommendations impossible to implement. In the present study, we invited prominent cardiac surgeon around the world to contribute in this survey, so we will be able to reduce the pitfalls mentioned above. However, due to a lack of precise measures to validate the questionnaire, our data may be flawed by the mentioned issues too.

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CONFLICT OF INTERESTS

All the authors declare that there are no conflict of interests.

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