Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

A nationwide survey of UK cardiac surgeons' view on clinical decision making during the coronavirus disease 2019 (COVID-19) pandemic

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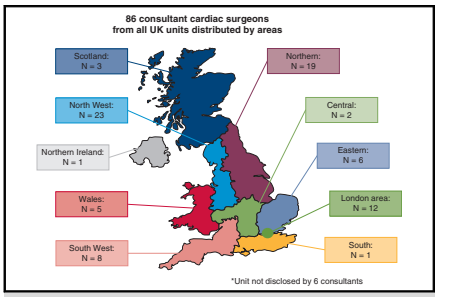
ABSTRACT

Background: No firm recommendations are currently available to guide decision making for patients requiring cardiac surgery during the coronavirus disease 2019 (COVID-19) pandemic. Systematic appraisal of senior surgeons' consensus can be used to generate interim recommendations until data from clinical observations become available. Hence, we aimed to collect and quantitatively appraise nationwide UK consultants' opinions on clinical decision making for patients requiring cardiac surgery during the COVID-19 pandemic.

Methods: We E-mailed a Web-based questionnaire to all consultant cardiac surgeons through the Society for Cardiothoracic Surgery in Great Britain and Ireland mailing list on the April 17, 2020, and we predetermined to close the survey on the April 21, 2020. This survey was primarily designed to gather information on UK surgeons' opinions using 12 items. Strong consensus was predefined as an opinion shared by at least 60% of responding consultants.

Results: A total of 86 consultant surgeons undertook the survey. All UK cardiac units were represented by at least 1 consultant. Strong consensus was achieved for the following key questions: (1) before any hospital admission for cardiac surgery, nasopharyngeal swab, polymerase chain reaction, and computed tomography of the chest should be performed; (2) the use of full personal protective equipment should to be adopted in every case by the theater team regardless of the patient's COVID-19 status; (3) the risk of COVID-19 exposure for patients undergoing heart surgery should be considered moderate to high and likely to increase mortality if it occurs; and (4) cardiac procedures should be decided based on a rapidly convened multidisciplinary team discussion for every patient. The majority believed that both aortic and mitral surgery should be considered in selected cases. The role of coronary artery bypass graft surgery during the pandemic was controversial.

Conclusions: In this unprecedented pandemic period, this survey provides information for generating interim recommendations until data from clinical observations become available. (J Thorac Cardiovasc Surg 2020;160:968-73)



Geographic distribution of responding consultants.

CENTRAL MESSAGE

In the current scenario, systematic appraisal of national expert consensus can represent a rapid and efficient instrument to support heath policy makers in generating interim recommendations.

PERSPECTIVE

Systematic appraisal of senior surgeons' consensus can be used to generate interim recommendations for patients undergoing cardiac surgery during the COVID-19 pandemic until data from clinical observations become available.

See Commentaries on pages 974, 976, and 977.

The coronavirus disease 2019 (COVID-19) pandemic has had an unprecedented impact on health care globally, including on the delivery of cardiac surgical care.[1,2] Cardiac surgery is the single largest user of intensive care unit beds.[1,2] The re-allocation of intensive care unit capacity to treat patients with COVID-19 has adversely affected the provision of routine cardiac surgery in the United Kingdom and worldwide. Urgent and emergency cardiac surgical procedures are still required by the public during the pandemic. There remain several areas of uncertainty. These include the risks incurred by patients with preexisting cardiac conditions, who may suffer fatal events if surgery is delayed by several weeks, the impact of acquiring

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Abbreviations and Acronyms

CABG = coronary artery bypass graft
COVID-19 = coronavirus disease 2019
CT = computed tomography
PCI = percutaneous coronary intervention
PCR = polymerase chain reaction
PPE = personal protective equipment

COVID-19 during the pandemic, and the and the anecdotal evidence that postoperative COVID-19 infection may be fatal.

No firm recommendations are currently available to guide decision making for patients requiring cardiac surgery during the pandemic. This can translate into significant variability in clinical practice and patients' outcomes across cardiac units. In these circumstances, consensus among senior surgeons nationally or globally can provide interim guidance for health care policy makers, for clinicians' daily practice, and for patients.[3] We aimed to collect and quantitatively appraise nationwide UK senior surgeons' opinion on clinical decision making for patients requiring cardiac surgery during the COVID-19 pandemic.

PARTICIPANTS AND METHODS

We E-mailed a Web-based questionnaire to a total of 198 consultant cardiac surgeons from 35 UK cardiac centers through the Society for Cardiothoracic Surgery in Great Britain and Ireland mailing list on the April 17, 2020. Our aim was to receive at least 1 response from each unit to inform a national picture of practice. In view of the rapidly evolving circumstances and the need for timely outcome presentation, we predetermined to close the survey on the April 21, 2020. This survey was primarily designed to gather information, using 12 items, on UK surgeons' opinions on which patients should be considered for cardiac surgery under the current COVID-19 pandemic. As at the time of the survey, there was significant variability in clinical activities across centers, the first part of the questionnaire gathered information on local factors (local resource relocation to treat COVID-19) that may have influenced surgeons'- views. Strong consensus was predefined as an opinion shared by at least 60% of responding consultants.[3]

RESULTS

A total of 86 consultant surgeons undertook the survey. There was at least 1 senior surgeon who took part to the survey from each of the 35 cardiac units. Figure 1 shows the distribution of responding consultants across different regions and the proportion of consultant stratified by local resource relocation. Geographic regions with the greatest number of responding consultants were London, North West, and Northern regions. Most consultants were from units in which resources were only partially redirected to treat COVID-19 (n = 63, 73%), followed by consultants working in units entirely relocated (n = 17, 18%), and only 9 consultants were from in units in which resources were not redirected (10%). Table 1 shows the results of the survey in the overall sample and in groups stratified by working in units with resource relocation.

In the overall sample, strong consensus (≥60%) was achieved for the following key questions: (1) before hospital admission every patient should receive nasopharyngeal swab, polymerase chain reaction (PCR) and computed tomography (CT) of the chest; (2) the use of full personal protective equipment (PPE) should to be adopted in every case by the theater team regardless of the patient's COVID-19

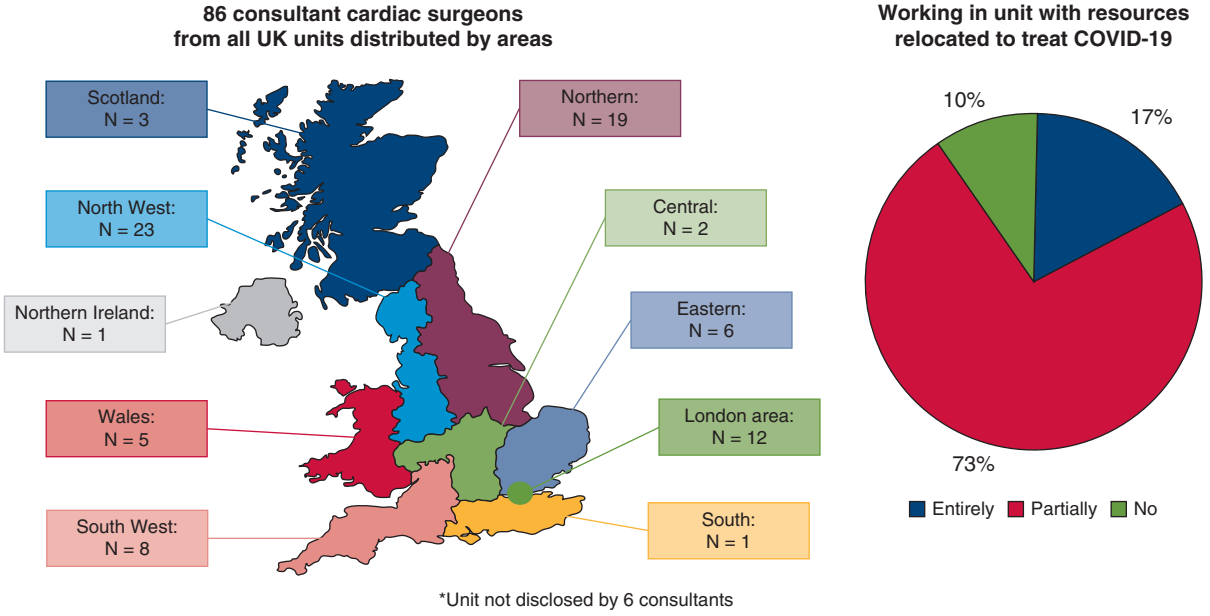

FIGURE 1. *Left*, Distribution of 86 consultants who responded to the survey across macro-areas in the United Kingdom. *Right*, Proportion of responders stratified based on whether they worked in units with resources relocated to treat COVID-19. *COVID-19*, Coronavirus disease 19.

TABLE 1. Results of the survey among 86 consultant cardiac surgeons (at least 1 from each UK unit) in the overall sample and stratified by resource relocation to treat COVID-19

Survey questions	Total	Resource relocated		
		No	Partially	Entirely
Screening for COVID-19 before patient's admission for nonsalvage cardiac surgery should consist of				
I do not know	1.2%	0.0%	1.6%	0.0%
Nasopharyngeal swab and PCR for suspected cases only	1.2%	12.5%	0.0%	0.0%
Nasopharyngeal swab, PCR, and CT of the chest for every patient	60.5%*	62.5%	65.1%	40.0%
Nasopharyngeal swab, PCR, and CT of the chest for suspected cases only	5.8%	0.0%	6.3%	6.7%
Nasopharyngeal swab, PCR for every patient	31.4%	25.0%	27.0%	53.3%
During this pandemic, full PPE should be adopted by the theater team				
I don't know	1.2%	0.0%	1.6%	0.0%
In every case regardless of the patient's COVID-19 status	60.5%*	62.5%	54.0%	86.7%
Only in a confirmed COVID-19 case or in all cases in which COVID-19 screening was not performed	17.4%	12.5%	22.2%	0.0%
Only in a confirmed or suspect COVID-19 case	20.9%	25.0%	22.2%	13.3%
During this pandemic, the risk of COVID-19 exposure for patients undergoing cardiac surgery is				
I don't know	3.5%	0.0%	3.2%	6.7%
Low but likely to increase mortality if it occurs	25.6%	12.5%	28.6%	20.0%
Moderate to high and likely to increase mortality if it occurs	69.8%*	87.5%	66.7%	73.3%
Moderate to high but unlikely to increase mortality if it occurs	1.2%	0.0%	1.6%	0.0%
During this pandemic, cardiac surgery operations should be performed				
As usual following standard recommendations	9.3%	0.0%	11.1%	6.7%
At surgeons' discretions	12.8%	12.5%	12.7%	13.3%
I don't know	1.2%	0.0%	1.6%	0.0%
Only after ad-hoc MDT for every case	64.0%*	50.0%	65.1%	66.7%
Surgery should never be performed unless strictly necessary (ie, dissection)	12.8%	37.5%	9.5%	13.3%
A patient confirmed or suspected of being COVID-19 positive presenting with acute type A dissection should be operated on				
I don't know	2.3%	12.5%	0.0%	6.7%
Only if he/she has no symptoms of infection (ie, no fever, normal blood cell count, normal CT of the chest)	22.1%	12.5%	23.8%	20.0%
Only if he/she has no symptoms of infection and has best chances of survival (ie, age)	53.5%	50.0%	60.3%	26.7%
Should be considered for surgery only if he/she is unstable (ie, cardiac tamponade)	17.4%	12.5%	15.9%	26.7%
Surgery should never be attempted	4.7%	12.5%	0.0%	20.0%
During this pandemic, elective surgery for patients without COVID-19 should be performed				
All elective cases with priority (ie, symptoms) to be considered for TAVI or PCI and surgery to be performed only if strictly necessary	40.7%	0.0%	42.9%	53.3%
As usual following standard recommendations	2.3%	0.0%	3.2%	0.0%
Only in cases with priority (ie, symptoms)	47.7%	62.5%	46.0%	46.7%
Surgery should never be performed	9.3%	37.5%	7.9%	0.0%
During this pandemic, surgery for inpatients without COVID-19 should be performed				
All inpatients to considered for TAVI or PCI and surgery to be performed only if strictly necessary	40.7%	12.5%	39.7%	60.0%
As usual following standard recommendations	11.6%	12.5%	14.3%	0.0%
Only in selected cases (age criteria, anatomy)	45.3%	50.0%	46.0%	40.0%
Surgery should never be performed	2.3%	25.0%	0.0%	0.0%

(Continued)

TABLE 1. Continued

Survey questions	Total	Resource relocated		
		No	Partially	Entirely
During this pandemic, CABG surgery for patients without COVID-19 should be performed				
As usual following standard recommendations	4.7%	12.5%	4.8%	0.0%
Neither CABG nor PCI should be performed unless strictly necessary (ie, STEMI, unstable angina)	22.1%	12.5%	22.2%	26.7%
Only in selected cases (ie, age criteria, left main disease)	40.7%	50.0%	44.4%	20.0%
PCI should always be the default strategy and CABG should be considered only in unstable patients when PCI is not feasible	32.6%	25.0%	28.6%	53.3%
During this pandemic, AV surgery for patients without COVID-19 should be performed				
Following standard recommendations	5.8%	12.5%	4.8%	6.7%
Neither AV surgery nor TAVI should be performed unless strictly necessary (unstable or very symptomatic patients)	30.2%	25.0%	31.7%	26.7%
Only in selected cases (ie, age criteria, bicuspid valve)	51.2%*	62.5%	54.0%	33.3%
TAVI should always be the default strategy and AV surgery should be considered only in unstable patients when TAVI is not feasible	12.8%	0.0%	9.5%	33.3%
During this pandemic, MV surgery for patients without COVID-19 should be performed				
Following standard recommendations	3.5%	12.5%	3.2%	0.0%
I don't know	2.3%	0.0%	0.0%	13.3%
MV surgery should never be performed unless strictly necessary (unstable or very symptomatic patients)	41.9%	37.5%	38.1%	60.0%
Only in selected cases (ie, age criteria, very symptomatic)	52.3%*	50.0%	58.7%	26.7%
After this pandemic, which of the following sentence will be true?				
Cardiac surgery activities will be significantly reduced in favor of interventional procedures (ie, TAVI, PCI)	10.5%	12.5%	9.5%	13.3%
Cardiac surgery activities will go back to normal	65.1%*	62.5%	65.1%	66.7%
I don't know	24.4%	25.0%	25.4%	20.0%
After this pandemic, future indications need be revised to account for other factors (ie, ICU bed use)				
I don't know	8.1%	12.5%	7.9%	6.7%
No	68.6%*	75.0%	66.7%	73.3%
Yes	23.3%	12.5%	25.4%	20.0%

COVID-19, Coronavirus disease 2019; *PCR*, polymerase chain reaction; *CT*, computed tomography; *PPE*, personal protective equipment; *MDT*, multidisciplinary team; *TAVI*, transcatheter aortic valve implantation; *PCI*, percutaneous coronary intervention; *STEMI*, ST-elevation myocardial infarction; *CABG*, coronary artery bypass graft; *AV*, aortic valve; *MV*, mitral valve; *ICU*, intensive care unit. *Strong consensus.

status; (3) the risk of COVID-19 exposure for patients undergoing heart surgery should be considered moderate to high and likely to increase mortality if it occurs; and (4) cardiac procedures should be decided based on ad-hoc multidisciplinary team for every patient. Although there was no strong consensus on other key questions, the majority (>50%) agreed that: (1) patients who tested positive for COVID-19 before salvage surgery (ie, dissection), should be considered for surgery only if they have no symptoms of infection and have best chances of survival (ie, age, malperfusion); and (2) aortic and mitral valve surgery could similarly be considered only in selected cases. Interestingly, opinion regarding who should have coronary artery bypass graft (CABG) surgery was much more varied. Although the most common answer was that CABG surgery should be considered only in selected cases (ie, age criteria or left main disease; 41%), approximately one third of the responding surgeons believed that percutaneous coronary intervention (PCI) should always be the default strategy (33%). Overall, a small number of surgeons believed that urgent or elective surgery should never be performed (2% and 9%, respectively). When the outcomes of the survey were stratified by resource relocation, surgeons from units in which resources were not relocated (ie, units that are carrying on as normal) showed a very strong agreement (>85%) that the risk of COVID-19 exposure for patients undergoing cardiac surgery is moderate to high and likely to increase mortality if it occurs. This group also showed the greatest proportion of surgeons believing that cardiac surgery should never be performed in urgent (25%) or elective

patients (38%). Finally, there was a strong consensus that this pandemic will not have an impact on surgical activities when normal operating conditions will be re-established.

COMMENTS

We are realizing that non–COVID-19 infection–related deaths may be an extremely important unintended consequence of the COVID-19 pandemic due to the re allocation of health resources. However, there is little direct evidence to inform the management of patients requiring cardiac surgery under the current rapidly evolving circumstances. Initial reports have suggested that non–COVID-19–related cardiovascular mortality and morbidity are likely to be significantly affected.[4] In particular, the number of cardiac surgeries has dramatically decreased as intensive care facilities and staff have been urgently redeployed to treat patients with COVID-19. Even though cardiac surgeons are still required to ensure that essential cardiac interventions are provided to the public, the risk of COVID exposure during hospital admission and its potential impact on surgical outcomes during hospital admission remains uncertain. In health care systems where surgeons' mortality rates are under public and regulatory bodies scrutiny, such as in the United Kingdom, surgeons may be reluctant to offer cardiac operations under the current circumstances. To avoid the risk of inappropriate risk adverse practice, UK regulatory bodies, including the Society for Cardiothoracic Surgery in Great Britain and Ireland, have decided to suspend surgeons' specific mortality, but national and unit outcomes remain under strict surveillance.

Anecdotal evidence suggests that patients are reluctant to go to a hospital during the COVID-19 outbreak.[4] Patient counseling is particularly challenging, as risk-stratification methods available do not account for COVID-19 exposure, and it takes more time and empathy than ever to help a patient give consent for their cardiac surgery.

In the United Kingdom, there are rich resources of routinely clinical data, including the National Adults Cardiac Surgical Audit, which will provide essential information on the impact of the COVID-19 pandemic on patients undergoing cardiac surgery. However, clinical observations are accumulating slowly due to drastic reduction of cardiac surgeries performed, and data-driven evidence results may not be available until late spring or early fall. As a result, no firm recommendations are available for case selection and clinical decision making in patients referred to cardiac surgery. In clinical scenarios without compelling evidence, expert consensus can provide information for interim clinical recommendations. The present survey collected opinions from senior cardiac surgeons in the United Kingdom, and results are consistent with recent recommendations made by the Society of Thoracic Surgeons.[5]

First, surgeons agreed that before hospital admission for cardiac surgery, screening needs to include nasopharyngeal swab, PCR, and CT of the chest for every patient during the pandemic. Screening is essential to contain the infections and avoid postoperative complications. The definite diagnosis of COVID-19 is based on the viral isolation or a positive result of PCR from sputum, or nasal swab, or throat swab. However, a high false-negative rate of PCR results for COVID-19 detection has been reported.[6] The combination of multiple diagnostic tests (ie, PCR and chest CT) reduces the risk of false-negative results. Although it is difficult to distinguish COVID-19 pneumonia from other viral pneumonia on CT findings alone, the utility of CT of the chest to detect early change of COVID-19 in cases that PCR tests show negative results has been largely emphasized.[6] Positive screening tests should lead to reconsideration of the risks and benefits of proceeding with surgery. These patients may be in the pre-phase of infection and are likely at greater risk of adverse outcomes following surgery. Most surgeons, and particularly those working in units currently unaffected by the pandemic, believed that the risk of COVID exposure for patients admitted for a cardiac operation is moderate to high and can have serious consequences on a patient's outcome. This is likely related to the fact that after cardiac surgery patients can be particularly vulnerable to pulmonary complications caused by COVID-19. Intense screening in patients referred to cardiac surgery is desirable to improve patient outcomes. However, if the pandemic continues for months, as anticipated by some researchers,[7] possible consequences of intense screening will need to be evaluated. For instance, it is unclear whether delay in treatment due to screening can result in adverse events in unstable patients and whether CT of the chest can be avoided in selected cases to mitigate the risk of radiation. Surgeons also agreed that the theater team should adopt full PPE for all the procedures performed during the pandemic. Although preoperative screening is desirable to minimize the risk of COVID transmission to the health care providers, the risk of false-negative results must always be considered. Cardiac surgery requires uniquely skilled individuals (cardiac operating room scrub and circulators, perfusionists, cardiac anesthesiologists, and perioperative caregivers) and the risk of exposure to COVID-19 can threaten their availability for future, more urgent procedures. However, it remains unclear whether the use of full PPE can negatively affect team performance (ie, communication, surgical vision and dexterity, and fatigue) and ultimately result in worse clinical outcomes.

There was strong consensus that each surgical case requires an ad-hoc multidisciplinary team decision and patient's selection at surgeon's discretion under the current circumstances was believed to be acceptable only by a very small number of responders. Clearly, multidisciplinary team discussion for each patient requires flexible

approaches, such as conference call discussions or e-mail exchanges, and consideration must be given to sensitive data protection and confidentiality and the need of maintaining clinical documentation standards.

There was no strong consensus with regards to specific types of cardiac procedures. However, the majority believed that both aortic and mitral surgery should be considered in selected cases. The role of CABG surgery during the pandemic was more controversial. Neither consensus nor majority was achieved for CABG surgery in selected cases (ie, left main). Despite recent controversies reported by public media,[8] one third of responders suggested that under the current circumstances PCI should always be the default strategy and CABG surgery should be considered only in unstable patients when PCI is not feasible. After cardiac surgery, patients are particularly vulnerable to respiratory complications, and the occurrence of COVID-19–associated pneumonia after CABG surgery is likely to be associated with significant morbidity and mortality. During the pandemic, PCI can represent a temporary solution for patients with complex coronary artery disease. However, no definitive evidence exists on the superiority of PCI over CABG in case of COVID-19 exposure.

Finally, there was a strong agreement that cardiac surgery activities will be entirely re-established at the end of the pandemic. Compelling evidence has recently proven that cardiac surgery remains the best treatment for many patients with cardiac disease despite new technologies and improvement in transcatheter and percutaneous interventions.[9,10]

In conclusion, during the COVID-19 pandemic, health care policy makers and hospitals not only need to consider methods for containing and treating these infections but how infection outbreaks may affect systems of care beyond the immediate infection. Clinical decision making for patients requiring cardiac surgery is particularly challenging under the COVID-19 pandemic, as data-driven evidence is still scarce. Worldwide and in the United Kingdom, the lack of firm recommendations for the management of patients requiring cardiac surgery can translate into unwarranted variation in clinical practice and patients' clinical outcomes across units. In the current unprecedented scenario, systematic appraisal of consensus from senior surgeons at a national or international level can represent a rapid and efficient instrument to provide support to heath policy makers and other stakeholders in generating interim recommendations to guide and support clinicians in the decision-making process.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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References

1. Haft JW, Atluri P, Alawadi G, Engelman D, Grant MC, Hassan A, et al. Adult cardiac surgery during the COVID-19 pandemic: a tiered patient triage guidance statement. *Ann Thorac Surg*. April 10, 2020 [Epub ahead of print].
2. Hassan A, Arora RC, Adams C, Bouchard D, Cook R, Gunning D, et al. Cardiac surgery in Canada during the COVID-19 pandemic: a guidance statement from the Canadian Society of Cardiac Surgeons. *Can J Cardiol*. April 8, 2020 [Epub ahead of print].
3. Kea B, Sun BC. Consensus development for healthcare professionals. *Intern Emerg Med*. 2015;10:373-83.
4. Tam CF, Cheung KS, Lam S, Wong A, Yung A, Sze M, et al. Impact of coronavirus disease 2019 (COVID-19) outbreak on ST-segment-elevation myocardial infarction care in Hong Kong, China. *Circ Cardiovasc Qual Outcomes*. 2020; 13:e006631.
5. The Society of Thoracic Surgeons. COVID-19. Available at: https://www.sts.org/covid-19. Accessed April 21, 2020.
6. Yang W, Sirajuddin A, Zhang X, Liu G, Teng Z, Zhao S, et al. The role of imaging in 2019 novel coronavirus pneumonia (COVID-19). *Eur Radiol*. April 15, 2020 [Epub ahead of print].
7. Leung K, Wu JT, Liu D, Leung GM. First-wave COVID-19 transmissibility and severity in China outside Hubei after control measures, and second-wave scenario planning: a modelling impact assessment. *Lancet*. 2020;395:1382-93.
8. Cohen D, Brown E. Surgeons withdraw support for heart disease advice. Available at: https://www.bbc.co.uk/news/health-50715156. Accessed April 21, 2020.
9. Makkar RR, Thourani VH, Mack MJ, Kodali SK, Kapadia S, Webb JG, et al. Five-year outcomes of transcatheter or surgical aortic-valve replacement. *N Engl J Med*. 2020;382:799-809.
10. Stone GW, Kappetein AP, Sabik JF, Pocock SJ, Morice MC, Puskas J, et al. Five-year outcomes after PCI or CABG for left main coronary disease. *N Engl J Med*. 2019;381:1820-30.

Key Words: COVID-19, cardiac surgery, consensus, survey, risk