The impact of COVID-19 pandemic on aortic valve surgical service: a single centre experience.

Dimitrios Vlastos MD[1], Ishaansinh Chauhan MD[1], Kwabena Mensah MD[1], Maria Cannoletta MD[1], Athanasios Asonitis MD[1], Ahmed Elfadil MD[1], Mario Petrou[1], Anthony De Souza MD[1], Cesare Quarto MD[1], Sunil Bhudia MD[1], John Pepper MD[1], George Asimakopoulos MD[1]

Affiliations: [1]Royal Brompton and Harefield NHS Foundation Trust, London, UK

Running title: COVID19 and aortic valve surgery

Data availability statement: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Funding: none

Conflict of interest disclosure: nothing to disclose

Institutional Review Board approval: audit project approval ID # 003929; programme # 002490 RBH Adult Hert

Corresponing author:

Dimitrios Vlastos MD

E-mail: dimitrisbvr@hotmail.com; d.vlastos@rbht.nhs.uk

Present address: 27 Patcham Terrace, Apartment 17 Mansbridge House, SW8 4EX, Wandsworth, London, UK

Phone: +44 7423742890

Abstract

Background

The coronavirus-disease 2019 (COVID-19) pandemic imposed an unprecedented burden on the provision of cardiac surgical services. The reallocation of workforce and resources necessitated the postponement of elective operations in this cohort of high-risk patients. We investigated the impact of this outbreak on the aortic valve surgery activity at a single two-site centre in the United Kingdom.

Methods and Results

Data were extracted from the local surgical database, including the demographics, clinical characteristics, and outcomes of patients operated on from March 2020 to May 2020 and compared with the respective 2019 period. The experience of centres world-wide was invoked to assess the efficiency of our services.

There was a 38.2% reduction in the total number of operations with a 70% reduction in elective cases, compared with a 159% increase in urgent and emergency operations. The attendant surgical risk was significantly higher [median Euroscore II was 2.7 [1.9-5.2] in 2020 versus 2.1 [0.9-3.7] in 2019 ($p=0.005$)] but neither 30-day survival nor freedom from major post-operative complications (re-sternotomy for bleeding/tamponade, transient ischemic attack/stroke, renal replacement therapy) was compromised ($p>0.05$ for all comparisons).

Conclusion

RBHT managed to offer a considerable volume of aortic valve surgical activity over the first COVID-19 outbreak to a cohort of higher-risk patients, without compromising post-operative

outcomes. A backlog of elective cases is expected to develop, the accommodation of which after surgical activity normalisation will be crucial to monitor.

Introduction

The severe acute respiratory syndrome coronavirus 2 and the attendant coronavirus-disease 2019 (COVID-19) emerged in December 2019, resulting in a pandemic declaration by the World Health Organisation by March 2020 [1]. By the end of May 2020 more than 6 million cases and 374,000 fatalities had been reported worldwide; for the United Kingdom, the reported incidence was 90,000 and almost 10,000 respectively [2]. This has imposed an unprecedented burden on the provision of healthcare services in general, and surgical treatment specificlly [3]. The postponement of elective cases and the redistribution of workforce and resources reshaped the dynamics of surgical activity [3, 4].

Our aortic surgery team, among other cardiac surgical teams, had the task to achieve a delicate balance between patients whose treatment could be safely postponed, versus patients with life-threatening advanced chronic or emergency disease, in the context of severely limited intensive care resources availability [5, 6]. On the one hand, Pan-London Emergency Cardiac Surgery (PLECS) protocol facilitated this by providing a centralised pathway to COVID-19 protected surgical facilities [7]. On the other hand, the correlation of cardiovascular risk factors with worse COVID-19 outcomes [8-10] as well as the occasionally unpredictable trajectory of aortic valve disease [11] further complicated this process.

Aims and objectives

The aim of this service evaluation report is to provide an objective assessment of the effects of COVID-19 pandemic on the cumulative aortic valve surgical activity at our institution. More specifically, the number of operations undertaken between March and May 2020 -via the modified cardiac surgery pathway- will be compared with the respective activity during the period from March 2019 to May 2019. In addition, a more detailed analysis regarding the

differential impact on elective versus urgent or emergency cases, as well as on patients with mild clinical disease versus severely symptomatic ones will be conducted. Lastly, we will investigate how surgical mortality was affected, especially given the self-explaining prioritization of severe and urgent/emergency cases.

Methods

Data were extracted from the local surgical database and analysed using the SPSS v20 software. They included the demographics and clinical characteristics of patients treated over the periods of interest, type of operations and their indication, as well as major post-operative complications (namely re-sternotomy for bleeding or tamponade, transient ischemic attack (TIA) or stroke, new need for renal replacement therapy (RRT), and 30-day mortality. Data with a non-gaussian distribution are expressed as median (interquartile range) and were analysed after transformation into ranks. Chi-square Fisher exact test was used to compare categorical clinical characteristics and outcomes during the two investigated periods. Independent sample t-test was utilised for parametric ordinal data. In all analyses, we used two tailed tests with $p < 0.05$.

Results

During March-May 2020 a total of 97 aortic valve surgical procedures were undertaken, versus 157 during the respective 2019 period (Table 1). 59% of the patients were operated on an urgent or emergency setting in 2020, versus 14% in 2019 ($p<0.001$; Table 1). There was a 70% decrease in elective cases in 2020, in contrast with a 159% increase in urgent/emergency cases ($p<0.001$). Similarly, 11.3% of the operations were for aortic valve endocarditis in 2020, versus 4.5% in 2019 ($p=0.038$). The proportion of re-do operations did not significantly differ (8.2% in 2020 versus 3.8% in 2019, $p=0.135$) and neither did the percentage of cases classified as NYHA III/IV and/or CCS III/IV (76.3% in 2020 compared with 64.3% in 2019,

p=0.112). Median Euroscore II was 2.7 [1.9-5.2] in 2020 versus 2.1 [0.9-3.7] in 2019 (p=0.005).

Importantly, despite the higher surgical risk of cases in 2020, the frequency of the investigated major post-operative complications was not adversely affected. More specifically, no fatalities within 30 days were reported, compared with one fatality in the respective 2019 period (p=0.58). Similarly, the incidence of re-sternotomy for bleeding or tamponade was 3.1% versus 6.4% (p=0.269), while the incidence of post-operative neurologic impairment in the form of TIA or stroke was 2.1% versus 1.9% (p=0.54), for the 2020 compared to the 2019 period, respectively. The incidence of renal dysfunction necessitating RRT was 9.3% during the outbreak, versus 5.1% (p=0.186) during the respective 2019 period.

Discussion

The intensity of COVID-19 had a major impact on the provision of surgical services worldwide [3-6]. The perioperative dependence of cardiac surgery patients on ITU care, on which a significant component of the pandemic response was placed, and the concomitant reallocation of staff and equipment particularly complicated their management [6, 12, 13]. In this context, Pan-London Emergency Cardiac Surgery (PLECS) service was formed to provide a centralised pathway for urgent and emergency cases in London [7]. Royal Brompton and Harefield trust was one of the two centres selected, based on its surgical capacity, location, and absence of Accident & Emergency department. These characteristics provided the capability of accommodating high surgical volumes in a COVID-19 free environment.

To this end, a stringent admission protocol was utilised. Patients were screened with 2 serial COVID-19 swabs as well as a CT scan performed in the immediate pre-operative period (2

days before the provisional operation date). A positive swab or any suspicious radiological findings would be an indication to defer the operation; in the interim the patient would be under the care of Respiratory Medicine until 2 negative COVID-19 swabs were provided. Patients transferred from other hospitals were treated as potentially COVID-19 positive and were barrier nursed in side rooms until their status could be determined. As a result, none of our patients contracted the disease over the investigated period, underlining the effectiveness of this protocol.

Given the lack of set standards to evaluate the effectiveness of our modified pathway in providing aortic valvular surgical treatment, the experience of similar centres worldwide could be invoked. On the one hand, the 38% total reduction in our cases compares non-inferiorly with the median reduction of 50-75% reported in a recent survey that included 60 cardiac surgical centres globally, most of which abandoned the provision of elective care [12]. On the other hand, an aortovascular disease centre in the UK managed to maintain its surgical volume during the investigated outbreak period and equally distribute availability between urgent or emergency and elective cases [13].

Moreover, the aforementioned findings highlight our clear prioritization of urgent and emergency during the outbreak period. Importantly, despite the increased attendant risk as quantified by the median Euroscore II comparison, surgical survivability was not compromised. In the same respect, the incidence of re-sternotomy for bleeding or tamponade, TIA/stroke or new need for RRT was not increased. However, the 70% reduction in elective activity suggests that a significant backlog of cases will develop. This would mainly include patients with asymptomatic or mildly symptomatic disease. Given the non-negligible occurrence of sudden cardiac death even in asymptomatic patients with advanced aortic disease (especially aortic stenosis [11]), following normalisation of operative activity across both sites, these cases should optimally be accommodated to minimise the possibility of any

preventable deaths. This is further highlighted by evidence form healthcare systems of routine limited capacity, where longer cardiac surgical waitlists have been associated with worse operative mortality [14].

Conclusions

Our aortic valve surgical services were significantly affected by the COVID-19 pandemic, resulting in prioritization of urgent and emergency cases and deferral of elective treatment. Despite the increased attendant surgical risk, perioperative mortality and major morbidity were not increased. It would be of interest to follow-up patients treated during the pandemic and investigate for longer-term consequences as well as to evaluate how the backlog of elective cases will be accommodated after normalisation of surgical activity.

Author contribution:

1. Dimitrios Vlastos - dimitrisbvr@hotmail.com; D.vlastos@rbht.nhs.uk (corresponding author): concept/design, data analysis/interpretation, drafting, critical revision
2. Ishaansinh Chauhan - I.Chauhan@rbht.nhs.uk; concept/design, data collection
3. Kwabena Mensah - K.Mensah@rbht.nhs.uk : critical revision, drafting
4. Maria Cannoletta - M.Cannoletta@rbht.nhs.uk : critical revision
5. Athanasios Asonitis - A.Asonitis@rbht.nhs.uk : data collection
6. Ahmed Elfadil - A.Elfadil@rbht.nhs.uk : data collection
7. Mario Petrou – M.Petrou@rbht.nhs.uk : critical revision
8. Anthony De Souza - A.De-Souza@rbht.nhs.uk : critical revision
9. Cesare Quarto - C.Quarto@rbht.nhs.uk : critical revision
10. Sunil Bhudia - S.Bhudia@rbht.nhs.uk : critical revision
11. John Pepper - J.Pepper@rbht.nhs.uk; concept/design, critical revision
12. George Asimakopoulos - G.Asimakopoulos@rbht.nhs.uk : concept/design, data interpretation, critical revision, approval

References

[1] World Health Organization. Naming the coronavirus disease (COVID−19) and the virus that causes it. 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it. Accessed October 2020.

[2] John Hopkins University Of Medicine. Coronavirus resource centre. Accessed October 2020.

[3] Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, O'Neill N, Iosifidis C, Griffin M, Mathew G, Agha R. Impact of the Coronavirus (COVID-19) pandemic on surgical practice - Part 1. Int J Surg 2020;79:168-179.

[4] Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, O'Neill N, Iosifidis C, Griffin M, Mathew G, Agha R. Impact of the Coronavirus (COVID-19) pandemic on surgical practice - Part 2 (surgical prioritisation). Int J Surg 2020;79:233-248.

[5] 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.

[6] Mohamed Abdel Shafi A, Hewage S, Harky A. The impact of COVID−19 on the provision of cardiac surgical services. J Card Surg 2020;35:1295− 1297.

[7] Hussain A, Balmforth D, Yates M, Lopez-Marco A, Rathwell C, Lambourne J, Roberts N, Lall K, Edmondson S; BSC Group. The Pan London Emergency Cardiac Surgery service: Coordinating a response to the COVID-19 pandemic. J Card Surg 2020;35:1563-1569.

[8] Zaim S, Chong JH, Sankaranarayanan V, Harky A. COVID−19 and multiorgan response. Curr Probl Cardiol 2020;45:100618.

[9] Khan IH, Zahra SA, Zaim S, Harky A. At the heart of COVID−19. J Card Surg 2020;35:1287−1294.

[10] Shafi AMA, Shaikh SA, Shirke MM, Iddawela S, Harky A. Cardiac manifestations in COVID−19 patients—A systematic review. J Card Surg 2020;35:1988−2008.

[11] Otto CM. Sudden cardiac death in patients with aortic stenosis: maybe it is not the valve? Heart 2020;106:1624-1626.

[12] 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 2020;142:300-302.

[13] Harky A, Harrington D, Nawaytou O, Othman A, Fowler C, Owens G, Torella F, Kuduvalli M, Field M. COVID−19 and cardiac surgery: The perspective from the United Kingdom. J Card Surg 2020;1−10.

[14] Seddon ME, French JK, Amos DJ, Ramanathan K, McLaughlin SC, White HD. Waiting times and prioritization for coronary artery bypass surgery in New Zealand. Heart 1999;81:586–592.

Table 1. Number and type of operations, risk assessment, and major post-operative complications

Period	**March-May 2019**	**March-May 2020**	**p-value**
Number of operations	157	97	NA
Type of operations			0.662
AVR	77	52	
AVR + CABG	32	15	
AVR + aortic	29	17	
AVR + MVR	8	3	
Multivalvular/complex	11	10	
Euroscore II (median [IQR])	2.1 [0.9-3.7]	2.7 [1.9-5.2]	0.005
Urgent/emergency setting	22 (14%)	57 (59%)	<0.001
NYHA III/ CCS III	101 (64.3%)	74 (76.3%)	0.112
Endocarditis	7 (4.5%)	11 (11.3%)	0.038
Re-do operations	6 (3.8%)	8 (8.2%)	0.133
Complications			
30-day mortality	1 (0.6%)	0 (0%)	0.580
Re-sternotomy for bleeding	10 (6.4%)	3 (3.1%)	0.269
TIA/stroke	3 (1.9%)	2 (2.1%)	0.540
New need for RRT	8 (5.1%)	9 (9.3%)	0.186

AVR: aortic valve replacement; CABG: coronary artery bypass surgery; CCS: Canadian Cardiovascular Society angina pectoris grading; MVR: mitral valve replacement/repair;

NYHA: New York Heart Association functional classification; RRT: renal replacement therapy; TIA: transient ischaemic attack