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

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# 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** 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 with only one of the two sites resuming operative activity and compared with the respective 2019 period. A similar comparison was conducted with the period between June 2020 and August 2020, when operative activity was restored at both institutional sites. The experience of centres world-wide was invoked to assess the efficiency of our services.

**Results** There was an initial 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). Recommencement of activity at both institutional sites conferred a surgical volume within 17% of the pre-COVID-19 era.

**Conclusions** Our institution 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.

**Trial registration** Not applicable


# 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 specifically [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. Moreover, surgical theatre availability in our institution was severely compromised during the first three months of our pandemic response, since one of the two sites served as an exclusive COVID-19 Extracorporeal Membrane Oxygenation (ECMO) referral centre. Operative activity was restored at both sites thereafter, significantly enhancing our surgical volume capability.

### 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- were compared with the respective activity during the period from March 2019 to May 2019. A similar comparison was performed with our activity between June 2020 and August 2020, when our surgical volume capability was enhanced by re-commencement of operations at both sites included in our institution. 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 was conducted. Lastly, we investigated 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 New York Heart Association (NYHA) class III/IV and/or Canadian Cardiovascular Society (CCS) class 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.

During June-August 2020, following resumption of surgical activity at both sites, a total of 130 aortic valve procedures were performed, compared with 97 during the first wave period (Table 1). 43% of the patients were operated on an urgent or emergency setting during June-August, versus 59% during the first wave (p=0.026; Table 1). In more detail, the absolute number of urgent or emergency cases did not change, in contrast with an 82% increase in the elective cases (p<0.001). No significant difference was detected in either the median Euroscore II risk classification, or any of the investigated post-operative complications (Table 1).

# 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 Intensive Care Unit (ICU) 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. All patients were screened with 2 serial COVID-19 swabs one taken within 72 hours of admission and a second taken on admission within 48 hours of their predicted operative date. Patients at home would need to shield completely for 14 days and would have a pre-admission workup including coved swab done 3 days prior to admission. They were then admitted 2 days prior to their surgery with a Covid risk determined as ‘GREEN’ (Covid negative). Patients transferred from other hospitals would only be transferred to our institution with a negative Covid swab obtained within 72 hours of transfer. As these patients had not been shielding, they were treated as potentially COVID-19 positive (Covid risk AMBER) and were barrier nursed in-side rooms until their status could be

determined. All patients had a CT scan performed in the immediate pre-operative period (1-2 days before the provisional operation date). A positive swab or any suspicious radiological findings would place the patient in the Red risk group (Covid positive) and 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. 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% initial 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]. Our surgical activity was further enhanced following recommencement of operations at both institutional sites, achieving a surgical volume within 17% of the respective pre-COVID-19 era. 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% initial reduction in elective activity suggests the development of a significant backlog of cases; this was mitigated by the resumption of operative activity at both institutional sites, which conferred a significant increase of elective activity by 82%. The backlog may 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.

# List Of Abbreviations

AVR: aortic valve replacement; CABG: coronary artery bypass surgery; CCS: Canadian Cardiovascular Society angina pectoris grading; COVID-19: Coronavirus-disease 2019; ECMO: Extracorporeal Membrane Oxygenation; ICU: intensive care unit; MVR: mitral valve replacement/repair; NYHA: New York Heart Association functional classification; PLECS: Pan-London Emergency Cardiac Surgery; RRT: renal replacement therapy; TIA: transient ischaemic attack

# Declarations

- **Ethics approval and consent to participate**

Our clinical audit (service evaluation study) was approved by the Royal Brompton Hospital audit department: audit project approval ID # 003929; programme # 002490 RBH Adult Hert. According to the National Clinical Audit and Patient Outcomes Programme commissioned by the Healthcare Quality Improvement Partnership on behalf of the National Health Service no need for consent was by definition deemed necessary, while the pertinent ethical framework was strictly adhered to, including the Caldicott Principle (1997), the Data Protection Act (1998), and the NHS Confidentiality Code of Practice (2003).

- **Consent for publication**

Not applicable

- **Availability of data and materials**

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

- **Competing interests**

We declare no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work; no other relationships or activities that could appear to have influenced the submitted work.


- **Funding**

Not applicable


- **Authors' contributions**

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# Table

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

| Period | March-May 2019 | March-May 2020 | June-August 2020 |
|---|---|---|---|
| **Number of operations** | 157 | 97 | 130 |
| **Type of operations** | | | |
| **AVR** | 77 | 52 | 61 |
| **AVR + CABG** | 32 | 15 | 18 |
| **AVR + aortic** | 29 | 17 | 29 |
| **AVR + MVR** | 8 | 3 | 8 |
| **Multivalvular/complex** | 11 | 10 | 14 |
| **Euroscore II** (median [IQR]) | 2.1 [0.9-3.7] | 2.7 [1.9-5.2]* | 2.8 [1.5-5.2]* |
| **Urgent/emergency setting** | 22 (14%) | 57 (59%)* | 57 (43%)* |
| **NYHA III or IV/ CCS III or IV** | 101 (64.3%) | 74 (76.3%) | 101 (77.7%) |
| **Endocarditis** | 7 (4.5%) | 11 (11.3%)* | 16 (12.3%)* |
| **Re-do operations** | 6 (3.8%) | 8 (8.2%) | 24 (18.4%) |
| **30-day mortality** | 1 (0.6%) | 0 (0%) | 3 (2.3%) |
| **Re-sternotomy for bleeding** | 10 (6.4%) | 3 (3.1%) | 10 (7.7%) |
| **TIA/stroke** | 3 (1.9%) | 2 (2.1%) | 4 (3%) |
| **New need for RRT** | 8 (5.1%) | 9 (9.3%) | 7 (5.4%) |

*$p<0.05$ for the comparison with the pre-COVID-19 era