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Cardiothoracic surgery during the Covid-19 pandemic: Perioperative care, safety, and surgical results

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Abstract

Background: Covid-19 was declared a pandemic by the World Health Organization (WHO) on 11 March 2020. Responses to this crisis integrated resource allocation for the increased amount of infected patients while maintaining an adequate response to other severe and life-threatening diseases. Though cardiothoracic patients are at high risk for Covid-19 severe illness, postponing surgeries would translate to increased mortality and morbidity. We reviewed our practice during the initial time of the pandemic, with emphasis on safety protocols.

Methods: From 11 March to 15 May 2020, 148 patients underwent surgery at the Department of Cardiothoracic Surgery of Centro Hospitalar Universitário de São João. The clinical characteristics of the patients were retrospectively registered, along with novel containment and infection prevention measures targeting the new coronavirus.

Results: The majority of adult cardiac patients were operated on an emergency basis. Hospital mortality was 1.9% (n = 2 patients). Most adult thoracic patients were admitted from home, with a diagnosis of neoplastic disease in 60% of patients. Hospital mortality was 3.3% (1 patient). Fifteen children underwent cardiothoracic surgery. There was no mortality. The infection prevention procedures applied, totally excluded the transmission of Covid-19 in the department.

Conclusion: While guaranteeing a prompt response to emergent, urgent, and high priority cases, novel safety measures in individual protection, patients circuits, and preoperative diagnoses of symptomatic and asymptomatic infection were adopted. The surgical results corroborate that it was safe to undergo cardiothoracic surgery during the initial time of the Covid-19 pandemic. The new policies will be maintained while the virus stays in the community.

KEYWORDS

cardiovascular diseases, Covid-19, respiratory diseases, surgical procedures

1 | INTRODUCTION

Without a vaccine, specific medication and a complete understanding of the behavior of the coronavirus and the natural history of patients with Covid-19 infection, it is certain that we will have to live with this new coronavirus for some time, either endemically with localized surges or with sudden major waves of infection. Although stricter confinement was very effective in

flattening the curve, it cannot last forever due to its health, social, and economic deleterious consequences. Of particular emphasis is the effect of the confinement on the decreased demand for medical attention of patients with severe and life-threatening diseases other than Covid-19.[1,2] A recent report from the United States revealed a decline of 65% in diagnostic cardiac catheterizations and 44% in percutaneous coronary interventions during the first 2 weeks of April.[2] Again, a paper from Nogueira et al[3] modeled overall increased mortality in our country during the pandemic, not only from undiagnosed deaths from Covid-19 but also from other diseases, as patients are staying away or are waiting too long before coming to the hospital, as they do not want to increase the burden on the health care system or are afraid of getting infected with the virus.

To understand if admissions on Centro Hospitalar Universitário de São João (CHUSJ), the major Hospital of the North of Portugal, with the largest Cardiothoracic Department of the Portuguese NHS, increased the risk of being infected or dying when submitted to cardiothoracic surgery during the Covid-19 pandemic, we retrospectively review our surgical results from 11 March to 15 May 2020.

2 | METHODS

Between 11 March and 15 May 2020, 148 patients underwent cardiothoracic surgery at the Department of Cardiothoracic Surgery of Centro Hospitalar Universitário de São João. The patients were divided into three groups—103 were submitted to adult cardiac surgery (ACS), namely coronary artery disease, valvular disease, or adult congenital heart surgery and their complications; 30 patients underwent adult thoracic surgery (ATS); and 15 children had pediatric cardiothoracic surgery (PCS). The population was characterized by demography and clinical variables; Euroscore II was computed for all adults submitted to cardiac surgery, and compared with actual mortality; the surgical results of all groups were displayed.

The study design, methodology, and results received the approval of the Centro Hospitalar Universitário de São João Research Ethics Committee.

2.1 | Statistical analysis

A descriptive analysis was performed for the entire cohort and for each of the groups and data presented as percentage (%), mean and standard deviation, median, range, or interquartile ranges (IQRs), according to its distribution. Specific group analyses were conducted using χ^2 tests or Fisher exact tests for categorical variables and Student t tests or Mann-Whitney for continuous variables, according to the dimension and distribution of the samples, respectively. The results were considered statistically significant if $P < .05$ was computed.

3 | RESULTS

3.1 | Adult cardiac surgery

3.1.1 | Demography and clinical presentation

The adult cohort was composed of 103 patients (Table 1), with a median age of 66 years old (range 22-85), and 65% were males.

TABLE 1 Adult cardiac surgery patients

Adult cardiac surgery (ACS)		
n = 103		
Gender—n (%)	Male, 67 (65%); female, 36 (35%)	
Age—median (range), y	66 (22-85)	
Comorbidities	N (%)	
Hypertension	65 (63.1)	
BMI > 30 kg/m^2	28 (27.2)	
Diabetes	38 (36.9)	
COPD	28 (27.2)	
Chronic renal disease	15 (14.6)	
Anemia	29 (28.2)	
Previous MI	37 (35.9)	
Left ventricular dysfunction	34 (33.1)	
Diagnosis	Cases (%)	Previous MI
Valvular disease	41 (39.8)	1
Coronary artery disease	33 (32)	27
Valvular and coronary artery disease	13 (12.6)	5
Ascending aortic disease	3 (29)	0
Other	9 (8.7)	4
Euroscore II—mean (±SD), range	4.7 (±6.9%), 0.5%-39%	
Surgery	N (%)	Urgent admission
CABG	33 (32)	26
Valvular surgery	39 (37.9)	14
Valvular surgery and CABG	13 (12.6)	10
Aortic surgery	3 (2.9)	1[a]
Other	15 (14.6)	13
Complications	N (%)	
Stroke	2 (1.9)	
Perioperative MI	3 (2.9)	
Hemostasis revision	1 (1)	
Low cardiac output syndrome	3 (2.9)	
Respiratory failure	2 (1.9)	
Cardiac reoperation	2 (1.9)	
LOS median (range)	7 (2-53)	
Hospital mortality	2 (1.9%)	

Abbreviations: BMI, body mass index; CABG, coronary artery bypass graft; COPD, chronic obstructive pulmonary disease; LOS, length of stay; MI, myocardial infarction.

[a]The two other aortic surgeries were performed emergently.

Coronary artery disease and severe aortic stenosis accomplished for 82.5% of surgeries (85 patients). Sixty-four patients (62%) were operated on an emergency basis—after emergency room admission for an acute coronary syndrome or congestive heart failure, with their condition being considered serious enough to warrant surgery before discharge; three patients underwent emergent surgery (after diagnosis and before the next working day), two of them with acute type A aortic dissection and a patient with acute cardiac tamponade after left ventricular free-wall rupture in the context of an acute myocardial infarction; the remaining 36 patients were admitted from home with a high priority indication for surgery.

Hypertension was a risk factor in 62.1% of patients, 25.2% had a body mass index (BMI) higher than 30, 37% had diabetes, and almost 80% of patients submitted to coronary artery bypass graft (CABG) had a prior myocardial infarction. The mean calculated Euroscore II was 4.7 (±6.9) % and ranged from 0.5% to 39%.

3.1.2 | Early outcome

Hospital mortality was 1.9% (n = 2). A frail 80-year-old patient, with a cardiac tumor, operated urgently for severe mitral valve inflow obstruction, convalescing from bacterial pneumonia, died with septic shock and an 81-year-old patient presenting emergently with cardiac tamponade, after a left ventricular free-wall rupture post-acute myocardial infarction, died with low cardiac output syndrome.

By 15 May, 75 patients were discharged, 5 patients transferred to their local hospitals in stable clinical conditions to continue medical treatment, and 23 patients were in the hospital. Median postoperative hospital length of stay for adults discharged was 7 days.

Major complications included two redo cardiac surgeries, three redo surgeries for chest wound complications, a hemothorax, and two perioperative strokes with sequelae (1.9%). The two cardiac redo surgeries included a redo mitral valve replacement for early severe mitral regurgitation after an initial mitral valve repair and the repair of a Gerbode defect after Commando surgery for aortic and mitral valve endocarditis; both patients are well and recovering in the ward. All other patients are in the ward recovering, except for the patient submitted to a thoracotomy after an initial aortic valve replacement, who is in intermediate care, for functional recovery. Due to the low mortality, a statistical analysis on mortality was not performed.

3.2 | Adult thoracic surgery

3.2.1 | Demography and clinical presentation

In this period of time, 19 males (63.3%) and 11 females (Table 2), with a median age of 62 (range 23-77) years old were submitted to thoracic surgery. Almost half of the patients (14 pts; 46.6%) had cardiovascular risk factors, mainly hypertension, diabetes, or dyslipidemia, and 11 patients (36.6%) presented with a history of COPD and/or smoking.

TABLE 2 Adult thoracic surgery

Adult thoracic surgery (ATS)		
n = 30		
Gender—n (%)	Male, 19 (63.3%); female, 11 (36.7%)	
Age—median (range) in years	62 (23-77)	
Comorbidities	N (%)	
Hypertension	11 (36.6%)	
Diabetes	5 (16.6%)	
Dyslipidaemia	10 (33.3%)	
COPD/smoking	11 (36.6%)	
Diagnosis	N (%)	
Lung cancer	15 (50%)	
Metastatic cancer	3 (10%)	
Pleural disease	8 (26.6%)	
Other	4 (13.3%)	
Surgery (n = 31)	Cases (%)	VATS (n)
Lobectomy	13 (41.9%)	13
Nonanatomic resection	6 (19.3%)	6
Pleural decortication	4 (12.9%)	2
Pleural scarification and apical resection	4 (12.9%)	4
Others	4 (12.9%)	2
LOT of drainage median (range), d	4	
	(1-28)	
Hospital stay median (range), d	4.5	
	(1-52)	
In-hospital mortality	1 (3,3%)	

Abbreviations: COPD, chronic obstructive pulmonary disease; LOT, length of time; VATS, video-assisted thoracic surgery.

Twenty patients underwent a lung resection, eight were operated for pleural-space disease, and two had a mediastinal tumor resection. One patient had a redo surgery for a chest wall complication. Lung cancer was present in 15 patients. The majority of this group, 18 patients (61.2%) was admitted from home, with a high priority indication for surgery.

3.2.2 | Early outcome

One patient, initially operated by Orthopedics for a thoracic spondylitis, complicated with pneumonia and empyema, despite a straightforward thoracic operation died with septic shock (hospital mortality 3.3%).

Ninety percent of surgeries were performed by video-assisted thoracic surgery (VATS). The median postoperative length of drainage was 4 (1-28) days.

3.3 | Pediatric cardiothoracic surgery

3.3.1 | Demography and clinical presentation

Fifteen children, eight males and seven females (Table 3), with a median age of 8 (range 2-63) months, underwent surgery during this period. Two surgeries in patients on respiratory extracorporeal membrane oxygenation (ECMO) were emergent—one for hemothorax and the other for decannulation. Four operations were urgent, in patients previously admitted with severe congestive heart failure, namely a late presenting transposition of the great arteries (TGA) and ventricular septal defect (VSD), mechanically ventilated before surgery, a patient with double outlet right ventricle (DORV), large VSD, and malposition of the great arteries, a patient with an atrioventricular septal defect and a patient with congenital lupus and atrioventricular complete heart block; two more patients with bacterial endocarditis, underwent urgent surgery—one after a truncus repair 5 years ago and the other after a Norwood surgery last year. The remaining seven were high priority surgeries due to increasing desaturation, congestive heart failure, or high risk of developing permanent pulmonary hypertension.

TABLE 3 Pediatric cardiothoracic surgery patients

Pediatric cardiothoracic surgery (PCS)	
n = 15	
Gender—n (%)	Male, 8 (53.3%); female, 7 (46.6%)
Age (months); median (range)	8 (2-63)
Type of intervention (*n*)	Diagnosis
Emergent surgery (2)	Hemothorax
	ECMO decannulation
Urgent surgery (6)	Transposition of great arteries and ventricular septal defect
	Double outlet right ventricle, ventricular septal defect, and malposition of great arteries
	Atrioventricular septal defect
	Congenital complete heart block
	Bacterial endocarditis (2)
High priority surgery (7)	Complete atrioventricular septal defect, ventricular septal defect, aortic coarctation, double outlet right ventricle, unbalanced atrioventricular septal defect with pulmonary stenosis, severe mitral regurgitation, intrapericardial teratoma
Postoperative period	
Complications (n)	Chylothorax (2)
ICU discharge (days)	5 (2-15)
Discharge home (n)	13

Abbreviations: ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit.

3.3.2 | Early outcome

There was no mortality or initial severe morbidity. Two patients developed a chylothorax and were medically treated with success. All patients were discharged from the intensive care unit (ICU) after a median postoperative period of 5 (range 2-14) days, and all have been sent home, except two patients on prolonged antibiotherapy for bacterial endocarditis. One of these was later operated by neurosurgery for a cerebral abscess and is recovering in the ward without sequelae.

3.4 | Covid infections

Two patients tested positive for Covid-19. A 79-year-old patient with coronary artery disease was operated in the incubation period of the disease, during the confinement period, when only symptomatic patients were tested for Covid-19. The second, a 4-month-old baby with a cardiac teratoma tested positive before admission and the surgery was safely delayed until recovery, which occurred 2 weeks after the initial test. His postoperative course was uneventful, with extubation in the operation room. In a referring hospital, two patients tested positive and his medical condition allowed a safe postponing of the cardiac surgery.

4 | DISCUSSION

The Oporto Metropolitan Region was the first to be hit and heavier than other regions of the country, a consequence of the close relationship with the shoe and textile manufactories of Italy and the textile and construction industry of Spain. The core of this area, the counties of Porto, Vila Nova de Gaia, Valongo e Gondomar hitted 6000-7000 infections per million, more than doubling the mean number of the entire country. The first case was diagnosed on 2 March; the first ICU admission on the 9th and by 11th 30 patients with Covid-19 had already been admitted to the CHUSJ, the major reference hospital for Covid-19 in that area.

Since the beginning of February, a Crisis Cabinet had been established,[4] anticipating the acquisition of protective equipment and Covid-19 tests, staff requirements, and foreseen new models of work organization. At the same time, the remodeling of the Emergency Department began, to create separate circuits for Covid-19 and non-Covid-19 patients, which was fully implemented by March. During the first week of March, the general access to the hospital was

restricted, with major restrictions in the out-patient clinic favoring telemedicine and by the second week of March, when Covid-19 was declared a pandemic by the WHO,[5] most of the elective surgeries had already been postponed.[4] The Faculty of Medicine canceled all classes on the 8th of March. Patient visits were limited on the 6th and then canceled by 13th March. Only one parent was allowed to stay in the hospital with his child and prohibited from leaving the premises during the entire stay, and only one relative was allowed to come into the hospital to bring in or take out the patients, at admission and discharge, respectively.

The CHUSJ was then prepared with fully separated Covid-19 and non-Covid-19 areas, including dedicated laboratory, X-ray, and CT (computed tomography) scan machines.

The Intensive Medicine Task Force issued on the 19th of March, an advisory document stating six Levels of Contingency for resource demand, according to the populational impact of the disease. However, this document emphasized the uttermost interest, of maintaining an adequate level of response to address severe and life-threatening diseases like cardiovascular, neurological, and oncological.

This document confirmed the implementation in the Department of Cardiothoracic Surgery of a policy of postponing elective cases and responding not only to urgent or emergent cases, but also maintaining a schedule of high priority cases, where a delayed intervention could highly impact on the medium-term survival or quality of life of patients.

It is well known that the majority of patients admitted for surgery in a Cardiothoracic Department, are at increased risk of infection and death with Covid-19, as they are frequently of old age, obese, hypertensive, and diabetic, with severe cardiac or pulmonary diseases.[6] Informal reports from Spain and Italy and a paper published by Lei et al,[7] reported a substantial mortality increase when surgical patients are infected with Covid-19. This was further highlighted in a report from Wang et al,[8] concluding that 41% of patients and 29% of the staff have contracted the infection in the hospital.

At this point, the department was confronted with a no-catch situation—postponing the surgeries would heavily impact the survival of cardiothoracic patients, and operating them could highly increase the risk for early mortality, if during hospitalization some of the patients get infected.

With the assistance of UPCIRA (Infection Prevention Department), Covid-19 free and Covid-19 circuits were created to decrease the propagation of Covid-19 and assure the safety of the patients and an operating room with a separated corridor set in place for surgery of Covid-19 patients, in case of necessity.

Policies to reinforce social distancing for both staff and patients, along with limiting personnel encounters in clinical and social areas, were adopted. Firm standards for environmental sanitation, namely floors, walls, surfaces, patient units, operating rooms, linen, and litter disposal, were set in place. Staff precautions were reinforced, including specific attire in the clinical areas. The compulsory use of the surgical mask in the hospital premises was implemented on the 15th of March for all staff and on the 6th of April to all patients.[4] In addition to the standard infection control precautions, contact and droplet precautions were adopted for all patients. When feasible, all aerosol-generating procedures were replaced by closed-circuit procedures and when indispensable, airborne precautions, including specific attire and high-efficiency filters were taken and personnel limited to a minimum.

In the early period, the hospital policy was to test symptomatic or epidemiological suspected patients, but on the 24th of March testing was extended to all patients before cardiothoracic surgery and by the 29th, to all patients before admission to the hospital and regularly during in-patient, revealing the dynamic pattern of decision-making during the pandemic.

In this period, about half of our department ICU nurses and anesthesiologists were transferred to the Covid-19 allocated Critical Care Units, with a consequent mean decrease of 48% in the regular surgical capacity, along with the cancellation of weekend additional surgeries.

We should highlight that our department runs its own postoperative care units. It facilitated the containment, with the surgical patients isolated from the Covid-19 areas, and favored the rescheduling of cases, as we could predict the vacancies, discharges, and mobilize patients to intermediate care and the ward at our own decision.

Of special note, only one patient was operated during the incubation period of the Covid-19 infection. This patient got fever in the immediate postoperative period, tested positive and was transferred on the first postoperative night to a Covid-19 ICU; another, a 4-month-old baby with an intrapericardial tumor, waited in an isolation room, tested positive and his surgery was safely postponed for 17 days after two negative tests; the last, a third infection was diagnosed in a staff doctor, being plausible that he also was infected outside the department. Two cardiac patients with surgical indication, tested positive in a referring hospital. Their surgery was safely postponed while they are recovering from the infection in the hospital. No transmissions were detected between patients, between staff and patients or patients and staff. These results are even more reassuring about the overall safety of these protocols, as 24% of the adult patients were transferred from other departments of the hospital and 40% of the ACS group from other NHS hospitals, and all children underwent the postoperative care in the Pediatric Intensive Care Unit.

The postoperative course of the patient operated with Covid -19 was complicated by viral pneumonia, requiring prolonged ventilation and was finally discharged home 53 days after surgery. The second, an infant with an intrapericardial teratoma was operated a week after testing negative, was extubated in the operating room, and no respiratory complications ensued. Although the numbers are small and lack statistical significance, they are in the same line with the paper of Lei et al,[7] reporting an excess morbidity and mortality if patients are operated while infected with Covid-19, those caused by respiratory or circulatory complications.

5 | CONCLUSION

During the first wave of the pandemic, in the most afflicted area of Portugal, with communitarian transmission of Covid-19 disease, it was safe to be admitted and operated in the Department of Cardiothoracic Surgery of CHUSJ.

The surgical results were not influenced by the Covid-19 pandemic. Only 1.5% of the patients tested positive, the surgery was safely postponed in patients with known disease and between patients, patients-staff, or staff-patients transmission of the disease was not recognized. In the case of preoperative diagnosis of the infection, if safe, it is advisable to postpone the surgery, as respiratory and cardiac complications seem to be more frequent and serious.

In the event of a second Covid-19 wave as many foresee, maintaining the described policies, as testing patients before admission, keeping the standards of sanitation, using protective gear and safe donning, while running its own postoperative vacancies, should allow the department to maintain a safe surgical schedule and prevent cardiovascular fatalities.

Cardiothoracic surgery is not in the frontline of Covid-19 but there are plenty of lives to be saved in the backlines.

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