Original Article

Cardiac surgery practice during the COVID-19 outbreak: a regionwide survey

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Background: Health systems worldwide have been overburdened by the "COVID-19 surge". Consequently, strategies to remodulate non-COVID medical and surgical care had to be developed. Knowledge of the impact of COVID surge on cardiac surgery practice is mainstem. Present study aims to evaluate the regional practice pattern during lockdown in Campania.

Methods: A multicenter regional observational 26-question survey was conducted, including all adult cardiac surgery units in Campania, Italy, to assess how surgical practice has changed during COVID-19 national lockdown.

Results: All centers adopted specific protocols for screening patients and personnel. A significant reduction in the number of dedicated intensive care unit (ICU) beds (–30.0%±38.1%, range: 0–100%) and cardiac operating rooms (–22.2%±26.4%, range: 0–50%) along with personnel relocation to other departments was disclosed (anesthesiologists –5.8%±11.1%, range: 0–33.3%; perfusionists –5.6%±16.7%, range: 0–50%; nurses –4.8%±13.2%, range: 0–40%; cardiologists –3.2%±9.5%, range: 0–28.6%). Cardiac surgeons were never reallocated to other services. Globally, we witnessed dramatically lower adult cardiac surgery case volumes (335 *vs.* 667 procedures, P<0.001), as institutions and surgeons followed guidelines to curtail non-urgent operations.

Conclusions: This regional survey demonstrates major changes in practice as a response to the COVID-19 pandemic. In this respect, this experience might lead to the development of permanent systems-based plans for future pandemic and may effectively help policy decision making when prioritizing healthcare resource reallocation during and after the pandemic.

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Introduction

Health systems worldwide have been overburdened by the "COVID-19 surge" with an unprecedented demand for diagnostics and treatment. Italy has been the first European country affected by this pandemic, and the third, beyond the United Kingdom and Spain, for the severity of the outbreak. Despite a series of attempts to control the spread of the infection, the prevalence rose significantly and led to a nationwide lockdown on 9th March 2020 that ended up only on May 4th. To date (4th June 2020), the total number of assessed cases is 234,013 and, at least, 33,689 patients died. There has been substantial regional variation within the country, particularly extreme in the populous northeast. A critical shortage of personal protective equipment (PPE), intensive care unit (ICU) beds, and respiratory ventilators became dramatically evident. Resources had to be reallocated leaving many patients, especially those with other ailments, without proper care (1). Consequently, strategies to remodel non-COVID medical and surgical care had to be developed. As far as cardiac surgery is concerned recent authoritative papers have disclosed possible roadmaps and proposed regional system reorganization models (2-5). Knowledge of the impact of COVID surge on cardiac surgery practice is mainstem. Given the inter-regional variations in the severity of the surge and in the baseline differences in healthcare resources, the opportunity to quantify the experience and changes implemented across regionwide setting is relevant to guide policy decision making when prioritizing healthcare resource reallocation during and after the pandemic. Indeed, operating capacity during the COVID-19 recovery period (phase 2) will have a dramatic impact on the time to clear the deferred cases backlog with a potential on morbidity and mortality rates (6). Present study aims to evaluate the regional practice pattern during lockdown in Campania. We present the following article in accordance with the MDAR reporting checklist (available at http://dx.doi.org/10.21037/jtd-20-2298).

Methods

A multicenter regional observational 26-question survey was conducted, including all adult cardiac surgery units in Campania, Italy, to assess how surgical practice has changed during COVID-19 national lockdown. Patients <18 years old were excluded from the study.

Redistribution of dedicated healthcare resources was investigated. Modalities for screening of surgical candidates along with roots of active surveillance of healthcare professional were analyzed. Availability of appropriate PPE was also recorded. All consecutive patients referred for surgery during the lockdown were included. Number, urgency status, type of surgical procedures, along with patterns of referral and discharge, as well as length of hospitalization were collected. These parameters where compared to those pertaining the equivalent period of 2019 practice.

Data collection

Each center retrieved data from their internal records or from Department of Management. Fill-in case reports were submitted to the coordinating unit at Department of Translational Medical Sciences, University of Campania, Naples, which was in charge for data collection, data analysis and report.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional committee board of Department of Translational Medical Sciences, University of Campania (registration number 7 obtained on the March 2nd, 2020). Informed consent was waived because the survey itself did not include any sensitive data.

Statistical analysis

Categorical variables are presented as count and percentage,

continuous data as means ± standard deviations. Data were compared with chi-square and paired-sample *t*-test. Statistical significance was set at an alpha level of 0.05. All analyses have been performed with IBM SPSS Statistic 24 for Mac OS.

Results

Among all 9 regional hospitals, 2 were academic (22.2%), 3 public hospitals (33.3%) and 4 private clinics (44.4%). Five were hub hospitals for COVID-19 patients.

Screening protocols and protective equipment availability

All centers adopted specific protocols for triaging of patients admitted to the hospital. Naso- and oro-pharyngeal swabs were the most performed preoperative screening tests for surgical candidates (6 centers 66.6%—swab only: 3 centers, swab plus serum tests: 3 centers). Rapid test was the preferred test in 2 (22.2%), serum antibodies in 1 (11.1%). Protocols of surveillance for healthcare professionals were implemented in all centers, ranging from self-assessment to body temperature, from swabs to rapid test to antibodies title or various combinations of them. Use of PPE was mandatory in all Centers and was sufficiently provided in 6 (66.6%), whereas only temporarily inadequate in 3 (33.3%). No intrahospital COVID outbreak was reported.

Resource allocation

Hospital services were redistributed to differentiate pathways for COVID-19 positive/suspect positive patients. Eight centers had dedicated area for triage (4 inside the ward; 4 outside the ward). Four centers had also an operative room dedicated to COVID-19 positive/suspect positive patients (in all cases inside the operating block). Seven centers had dedicated ICU beds available for patients with positive or on-going screening tests (5 inside the cardiac ICU; 2 in the general ICU).

Eight centers (88.9%) experienced a reduction of resources during the lockdown. In particular, the ICUs were mostly involved, with an average bed reduction of –30.0%±38.1% beds (range: 0–100%) compared to 2019 standards, followed by operative rooms (–22.2%±26.4%, range: 0–50%) and wards (–14.6%±22.5%, range: 0–50%). As far as professionals were considered, 4 centers experienced a reduction of personnel. In particular, the greater reallocation involved the anesthesiologists (–5.8%±11.1%, range: 0–33.3%), followed by perfusionists (–5.6%±16.7%, range: 0–50%), nurses (–4.8%±13.2%, range: 0–40%), and cardiologists (–3.2%±9.5%, range: 0–28.6%). The staff of cardiac surgeons was never reallocated to other services in all centers. The admittance of relatives was forbidden in 6 centers and limited in 3. When relatives were not allowed to visit patients, bulletins were provided by telephone in all cases (1 center also allowing consultation in dedicated spaces). In the other 3 centers, consultations with the referring physician were available in dedicated spaces before surgery, at the end of surgery and during the whole hospital stay until discharge.

Referral, operative planning, and surgical volumes

Patterns of referral significantly changed compared to the equivalent period of 2019 practice (*Table 1*). In particular, there was a significant reduction of patients admitted from the waiting lists (21.3% during lockdown *vs.* 39.3% in the 2019) in favor of an increased referral by the emergency contact (15.0% *vs.* 13.1%), in-hospital consultations (35.4% *vs.* 28.8%) or peripheral hospital referral (28.0% *vs.* 16.0%). The absolute distribution of the etiologies was similar between the two study periods, with acute coronary syndromes (ACS) and valvular heart diseases being the main diagnoses. A significant drop of surgery for chronic coronary artery diseases (CADs), along with a relative increase of acute aortic syndromes were also observed (*Figure 1*). Operative planning was regular only in 4 centers, whereas in the other 5 was impaired by resource allocation (mainly delayed diagnostics and reduced availability of blood substitutes). Accordingly, overall procedural volume was significantly reduced during lockdown compared to 2019 (335 *vs.* 667 procedures, P<0.001). Notably, the percentage of elective surgery dropped significantly, in favor of urgent and emergency procedures (*Tables 1*,*2*). Details on the surgical procedures performed are reported in *Figure 2*.

Length of hospitalization and patterns of discharge

Four centers (44.4%) reported an increase in the average postoperative length of stay compared to the equivalent period in 2019 (17.3±4.6 *vs.* 10.7±2.3 days, P<0.001). During the lockdown, only 2 centers did not change their pattern of discharge, maintaining the usual standard of care. On the other hand, 6 centers preferably discharged home and 1 center (11.1%) kept sending patients directly to a rehabilitation facility.

Table 1 Details of procedures performed during lockdown, compared to the same period of 2019

Details	Lockdown 2020	2019	P
Procedural volume, n	335	667	<0.001
Elective, n (%)	96 (28.7)	478 (71.7)	
Urgent, n (%)	207 (61.8)	150 (22.5)	
Emergency, n (%)	19 (5.7)	26 (3.9)	
Salvage, n (%)	13 (3.9)	13 (1.9)	
Referral, n (%)			<0.001
Emergent surgery	38 (15.0)	81 (13.1)	
Urgent surgery from inpatient	90 (35.4)	178 (28.8)	
Urgent surgery from regional referral	71 (28.0)	99 (16.0)	
Waiting list*	54 (21.3)	243 (39.3)	
Other	1 (0.4)	1 (0.2)	
Unknown	0	17 (2.7)	

*, Outpatients called from the center waiting list.

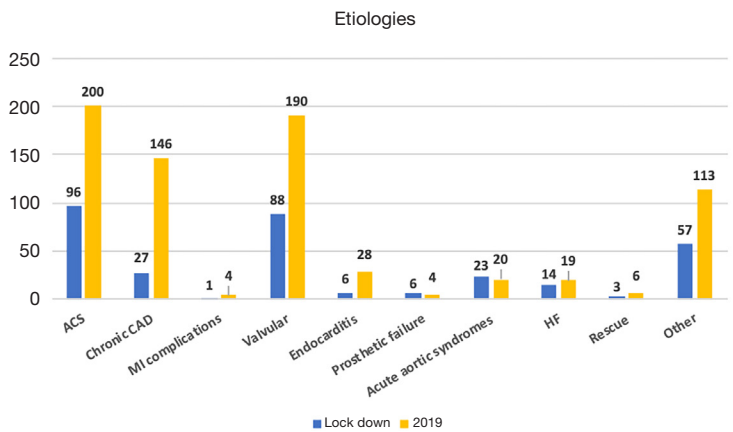

Figure 1 Distribution of etiologies between the two study periods. ACS, acute coronary syndromes; CAD, coronary artery disease; MI, myocardial infarction; HF, heart failure.

Discussion

The current pandemic has had an unprecedented impact on healthcare. We herein quantified the experience and changes implemented across adult cardiac surgery centers within Campania region. Boosting and optimizing the capacity of health systems to respond to the surge has been one of the major challenges. Policy responses had to be organized along three key priorities: staff, supplies, and space. A significant reduction in the number of dedicated cardiac operating rooms and ICU beds along with personnel relocation to other departments was indeed disclosed. As these systems-based changes were evolving, guidelines with adequate specificity to address the complexity of decision-making for safely and effectively performing and/or deferring cardiac surgery were unavailable or, under development, at best (2-5). As a result, many hospital systems in combination with their heart teams developed program-specific policies. As an example, a recent authoritative paper described such reorganization pathways and management algorithms in Lombardy region (7). As a matter of fact, in Campania, preoperative screening

Table 2 Breakdown of type of procedures by emergency status

Etiology	Elective	Urgent	Emergent	Salvage
CABG				
Lockdown	16	100	0	0
2019	195	61	5	0
Valve				
Lockdown	14	90	1	0
2019	98	75	0	0
TAVI				
Lockdown	29	2	0	0
2019	30	1	0	0
Ascending aorta/arch replacement/endovascular				
Lockdown	26	4	6	0
2019	35	6	8	0
VAD/HTX/ECMO				
Lockdown	2	5	3	3
2019	2	7	1	2
Other				
Lockdown	9	6	9	10
2019	118	0	12	11
Total*				
Lockdown	96	207	19	13
2019	478	150	26	13

*, As reported in *Table 1*. Valve: repair, replacement. CABG, coronary artery bypass graft; TAVI, transcatheter aortic valve implantation; VAD, ventricular assist device; HTX, heart transplantation; ECMO, extracorporeal membrane oxygenation.

for COVID-19 disease status and algorithms of active surveillance for healthcare providers significantly differed from one institution to another. Similarly, modalities for access of patients' relatives to surgical wards, length of postoperative hospitalization and patterns of discharge widely varied. Notably, hospital LOS and the patterns of discharge were also affected by the COVID-19 pandemic. The competition for diagnostics, the scarcity of blood products, the need to maximize patient health status before discharge in times of limited access to cardiac surgery outpatient clinics, along with the scarcity of rehabilitation facilities, are among the factors which synergistically contributed to these practice changes. Usually, resource availability is not factored in the decision-making process and the choices of an individual clinical or surgical case (8). PPE has been an important and emotive subject during the current pandemic: appropriate use significantly reduces risk of viral transmission, but a worldwide limited availability has become critically evident (9). Shortage of PPE has been experienced in variable degrees in the Campania surgical centers, with one-third suffering from a critical scarcity. Nevertheless, the satisfactory freedom from infection of cardiac surgery health care workers and lack of intrahospital COVID-19 outbreaks testifies for the efficacy of such "homemade" management pathways and judicious deployment of limited resources. Two data might be worth a comment. First, coronary surgery for ACS significantly and worryingly dropped during the lockdown. This unexpected pattern mirrors that reported by an Italian nationwide cardiologists' survey reporting a dramatic reduction in

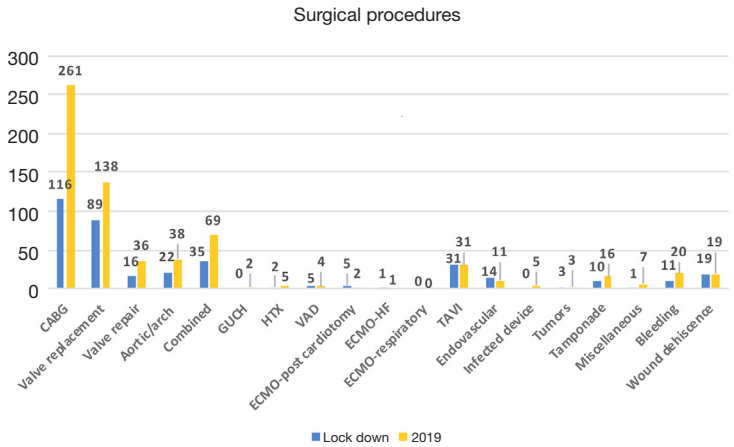

Figure 2 Specific surgical volumes during the two study periods. CABG, coronary artery bypass graft; GUCH, grown up congenital heart disease; HTX, heart transplantation; VAD, ventricular assist device; ECMO, extracorporeal membrane oxygenation; TAVI, transcatheter aortic valve implantation.

admissions for acute myocardial infarction (MI) during the lockdown and an escalation of inherent mortality and complication rates (10). Second, the number of transcatheter aortic valve implantations (TAVIs) appeared unaffected by the COVID-19 surge. Again, this pattern is homogeneous to that reported by a contemporary survey and testifies of modified treatment algorithm for severe aortic stenosis in times of limited healthcare resources (11,12). Globally, we witnessed dramatically lower adult cardiac surgery case volumes, as institutions and surgeons followed guidelines to curtail non-urgent operations. The median reduction in cardiac surgery case volume was 53.5% (IQR: 39.6–81.9%). Such a pattern is consistent with recently published international surveys (11,12). Most centers restricted cardiac surgery activity to urgent/emergent cases; 6 centers had cancelled elective cases. Such a decrease has had obvious positive effects. Indeed, it spared limited hospital resources, prevented in hospital spreading of COVID-19 and limited unnecessary risk of operating on asymptomatic patients within the infection incubation period. The drawbacks of such practice patterns are less clear now, but the outlook is not optimistic. Indeed, contemporary mortality rate while waiting for elective cardiac surgical procedures are still relevant. As an example, patients needing surgical or percutaneous aortic valve replacement experience mortality rates up to 3.7% at 1 month and 11.6% at 6 months (13). In patients listed for surgical myocardial revascularization waiting list mortality averages 6% per month, with risk increasing 11% per month, with a concurrent significant incidence of acute MI (14). More, increased mortality has been previously reported by healthcare systems in the aftermath of natural disasters (15,16). As a matter of fact, clearance of backlog cardiac surgical cases will be complicated by exhaustion of supplies and resources from the pandemic, and competition with similar needs by other medical and surgical subspecialties. In this respect, data reported in this paper may effectively help policy decision making when prioritizing healthcare resource reallocation after the pandemic (17). All in all, the pattern described herein adds to the concerning observation that excess non-COVID-19 mortality may lately overcome that directly related to COVID-19 infections.

Study limitations

Present study suffers from several limitations. First, it is a snapshot of a rapidly evolving situation within a context of limited resources and unsettled practice guidelines during an unprecedented pandemic. Second, the survey design implies an inherently potential for subjectivity. Third, we have assumed that historical rates of surgery might provide a valuable benchmark to quantify surgical backlog and thus post surge need for cardiac surgery escalation.

Conclusions

In conclusion, this regional survey demonstrates major changes in practice as a response to the COVID-19

pandemic. The cardiac surgical network responded expeditiously and effectively despite severe shortage of healthcare resources in terms of space, staff, PPE and despite the absence of available specific guidelines. In this respect, this experience might lead to the development of permanent systems-based plans for future pandemic. Finally, present survey quantifies at large the backlog of cardiac surgical procedures. These data may effectively help policy decision making when prioritizing healthcare resource reallocation after the pandemic.

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Footnote

Reporting Checklist: The authors have completed the MDAR reporting checklist. Available at http://dx.doi.org/10.21037/jtd-20-2298

Data Sharing Statement: Available at http://dx.doi.org/10.21037/jtd-20-2298

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jtd-20-2298). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional committee board of Department of Translational Medical Sciences, University of Campania (registration number 7 obtained on the March 2nd, 2020). Informed consent was waived because the survey itself did not include any sensitive data.

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