

Cardiac Surgery in the time of the Novel Coronavirus: Why we should think to a new normal

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Abstract

On March 11, 2020, the World Health Organization (WHO) declared the SARS-CoV-2 outbreak a pandemic: it took a toll of more than 300.000 deaths and more than 4.5 million cases, worldwide. The initial data pointed out the tight bond between cardiovascular diseases and worse outcomes in COVID19-patients. Epidemiologically speaking, there is an overlap between the age-groups more affected by COVID-related death and the age-groups in which Cardiac Surgery has its usual base of patients. The Cardiac Surgery Departments have to think to a new normal: since the virus will remain endemic in the society, dedicated pathways or even dedicated Teams are pivotal to treat safely the patients, in respect of the safety of the health care workers. Moreover, we need a keen eye on deciding which pathologies have to be treated with priority: Coronary Artery Disease (CAD) showed a higher mortality rate in patients affected by COVID19, but it's however reasonable to think that all the cardiac pathologies affecting the lung circulation - such as symptomatic severe mitral diseases or aortic stenosis - might deserve a priority access to treatment, in order to increase the survival rate in case of an acquired-Coronavirus infection later on.

Editorial

Introduction

In early December 2019, a series of cases of pneumonia emerged in Wuhan, Hubei, China. Respiratory tract samples revealed a novel coronavirus that was named *2019 novel coronavirus* (2019-nCoV) and then *Severe acute respiratory syndrome coronavirus 2* (SARS-CoV-2), based on the clinical presentation in the symptomatic cases(1). On March 11, 2020, the World Health Organization (WHO) declared the SARS-CoV-2 outbreak a pandemic due to the increasing number of cases outside of China. Patients with SARS-CoV-2 infection can develop coronavirus disease 2019 (COVID-19), which has resulted in high rates of hospitalization and intensive care unit (ICU) admissions. According to the WHO daily report, we are facing a global pandemic with nearly all countries affected, over 5 million cases, and over 330.000 deaths. This viral outbreak is worrisome because of the enormous pressure it exerts on health and economic systems. Despite lack of understanding of the exact pathophysiological mechanisms of SARS-CoV-2, cardiac involvement appears to be a prominent feature in symptomatic patients. Furthermore, it has been demonstrated that cardiac involvement,

even when subclinical, is both prevalent and a prognostic factor for affected patients(2). It has been noted that elevated cytokine levels (3,4) and hypercoagulable disorders and severe thrombo-embolic complications are frequent in patients with more severe COVID-19. It has been acknowledged that the primary infective mechanism occurs with engagement of the SARS-CoV-2 spike proteins onto the Angiotensin-converting enzyme 2 (ACE2). Therefore, it is reasonable to assume that direct myocardial involvement in COVID disease could be mediated by these receptors, particularly expressed in myocardial pericytes, which spread outside the endothelium of venules and capillaries.

From Epidemiology to Cardiac Surgery

Among patients infected by SARS-CoV-2, individuals with clinical comorbidities represent the group with the highest risk of experiencing a fatal event(5). This finding is especially relevant in societies with an aging population, as the prevalence of pre-existing diseases is higher in older age groups. Existing evidence about age-specific Case-Fatality Rate (CFR) of COVID-19 shows a substantial increase for age groups older than 70 years old. For example, data from China show that CFR for age groups 70-79 and 80 and over to be 8% and 14.8%, respectively. On the contrary, CFR's fell below the 4% range in younger age groups(6). These age-specific CFRs, in combination with the age-structure of the population, lead to an observed higher number of COVID-19 deaths amongst ages 70 and over in advanced societies(7).

Additionally, both ageing and cardiovascular comorbidities do affect the immune function, potentially increasing the COVID-19 susceptibility and severity(8). Existing evidence highlights two links between coronavirus infection and cardiovascular disease: 1) patients with symptomatic COVID-19 have cardiovascular comorbidities in a significant percentage of cases(9) and 2) the presence of cardiovascular comorbidities appears to be a risk factor for developing more severe COVID-19(10). However, classifying comorbid cardiovascular diseases (CVDs) in patients with COVID-19 has received little attention. To the best of our knowledge, academic reports regarding clinical features of COVID-19 have not clearly reported cardiovascular disorders in details or valvular pathologies prevalence(11).

Regarding cardiac surgery activity, we are witnessing a growing trend of degenerative valvular diseases, while the rheumatic pathology has had an abrupt decline: this explains the increased prevalence of valvular disease in ageing populations. The increasing prevalence of aortic stenosis (AS) and mitral regurgitation (MR) among older age groups is supported by several empirical studies(12,13). An analysis of temporal trends from 108,687 isolated aortic valve replacements in the Society of Thoracic Surgeons (STS) database between 1997 and 2006 showed that the percentage of patients aged more than 80 increased from 13 to 20% (14). Furthermore, recent studies have confirmed that age-distribution pattern of patients undergoing cardiac surgery: in the 2018 German Report (15) the age distribution of patients demonstrated a continuous shift toward an elderly population, with 34.8% of the cardiac procedures being performed in patients from 70 to 79 years of age, and 17.6% in octo-/nonagenarians. Overall, these findings suggest that the higher prevalence of valvular disease with therapeutic indications (either surgical or interventional) occurs within and after the seventh decade of life.

In epidemiological terms, it would be reasonable to consider a comparison of the age-profile overlap among patients who suffered from more severe COVID-19 with patients who undergo cardiac surgical procedures, since both prevalence of valvular diseases and case-fatality rates for COVID-19 increase in the elderly patients. Then, reasonably, in the population at risk for more severe COVID-19 there would have been some patients with significant cardiac disorder of surgical interest. The pandemic has forced the imagers to reconsider how best to perform cardiac imaging in the right patients at the right time to minimize the risk of cross-infection(16), then the real prevalence of severe valvular diseases was not thoroughly investigated. We definitely need more data in order to precisely analyze how many COVID-19 patients would have had a worse health outcome, dependent upon different coronary or structural cardiac pathologies. In addition, it would be intriguing to see how patients who have undergone successful cardiac surgery fared if they acquired mild to severe COVID-19. Definitely, the cardiac surgery activity has to adapt to the new circumstances and

keep on working.

A new normal

The pandemic affects our daily routine as cardiac surgeons in multiple ways: limited intensive care unit (ICU) beds and ventilators, necessity to postpone elective and/or complex cardiac surgeries, shortage of healthcare workers, sickness of healthcare staff and/or risk of infection of our Teams, risk of developing COVID-19 after cardiac surgery, and patients with COVID-19 needing urgent cardiac operations without having a properly organized operating room and ICU. The pandemic has hit every health system and the first bailout strategy was to maximize available ICU resources by discontinuing elective surgical activity. As Cardiac Surgeons, treating potentially life-threatening conditions on a daily basis, we seek direction from the National Cardiac Surgery Societies: nothing has been clearly stated about the triage process in severe valvular diseases. We believe that a comprehensive reorganization of our activities should be considered. Indeed, the system should aim to keep as much as ICU resources available for COVID-19 patients and at the same time, segregate the positive COVID-19 cases.

Should we consider a “*regional*” reorganization as well as a “*hospital*” reorganization? In the beginning of March, during the most dramatic phase of the emergency in Italy, the “hub center” system was established in Lombardy by the Regional Government. They identified few hub Centers that would address the urgent and emergent pathologies, leaving the other hospitals available for COVID-19 patients(17). Mainly established to address the shortage of beds and medical resources we experienced in the first phase, the “hub center” system might be extremely operational even later, with a different arrangement to treat elective but *SARS-CoV-2 positive* patients. The foundation of a SARS-CoV-2 Hub Center seems to be an option to eradicate the risk of in-hospital infection in non-COVID-19 patients, who are the most at risk, as long as the safety of health care workers is guaranteed. If we consider the peculiarity of the coronavirus-related syndrome and its pathogenetic mechanisms, a dedicated Center might offer a proper treatment before and after surgery, in terms of intensive care and pharmacological therapy: centralization and volume are pivotal to build expertise and improve quality of care, while reducing costs(18). This setting may have some drawback: Hospital chains may be able to reorganize and distribute patients to specific centers, only if both expenses and profits can be equally shared. Moreover, this may not be sustainable with individual stand alone institutions.

As far as “hospital” reorganization, every Institution has been allowed to determine the proper pathway upon which to open their operating schedules: in the GVM Care&Research hospital network, we have devised a flow chart to ensure a proper treatment to every patient (Fig. 1). After a phone triage seven and one days before hospitalization, we identified two main screening tools: the nasopharyngeal swab and the lung CT scan. While waiting for the results, the patient is placed in a single occupancy room (the so-called *bubble room*), having care to stay inside. When the tests are negative, he is enrolled in the *covid-free* pathway to surgery; in case of positive, a dedicated heart team evaluate the treatment priority and the patient will receive either intervention in a dedicated *covid+* hospital wing or treatment for the coronavirus infection.

We are heading to a *new normal*, working through the SARS-CoV-2 era, adjusting our daily practices with various safety measures. This also means being ready to face future waves of the pandemic and to working amongst a population with a small but still present portion of positives. We have to be prepared to preserve the safety of health care workers and hospital admitted patients, while having dedicated OR, ICU and ward beds to treat COVID-19 patients: indeed, the access to a proper and timely treatment cannot depend on the outcome of a swab.

To reach those goals, it is necessary to screen and segregate the positives with dedicated pathways for further diagnostic testing and treatment, regardless of the admitting diagnosis. A committed health care team would be ideal: chosen among the immunes (if this coronavirus generates a consistent and persistent immune response) or among those with less risk factors to develop a severe COVID-19. To stress this idea, the foundation of a SARS-CoV-2 Hub Center seems to be an option to eradicate the risk of in-hospital infection in non-COVID-19 patients, who are the most at risk. Regarding pathologies that merit priority

for treatment, it is reasonable to focus on those valvular diseases that directly may have an associated degree of pulmonary hypertension (PH). PH associated with left heart disease (Nice group 2) is by far the most common cause of PH and accounts for 50–85% of the cases. Based on the pathological findings and on the suspected mechanism of lung damage, an increased pressure in the pulmonary artery may further compromise the effective oxygen/carbon dioxide exchange in the alveoli. Rest echocardiography is essential to assess the presence of pulmonary hypertension in the symptomatic patient with left side valvular diseases. Furthermore, in order to correctly identify and stratify asymptomatic patients with a degree of pulmonary hypertension, exercise echocardiography is crucial. The prevalence of PH almost doubles under effort in patients with mitral regurgitation and increases almost 10 fold in asymptomatic patients with severe aortic stenosis(19).

Conclusion

COVID-19 has remarkably affected thousands of lives all over the world. As a medical community, we have to organize healthcare resources to also face the usual pathologies that are still threatening our patients. The cardiac surgical community should reorganize and offer a system to treat the surgical population safely and efficiently: we should look for strategies to screen patients properly, to protect health care workers and to stratify procedures based on surgical priority and postoperative resource consumption. We need to consider that cardiac pathology could further endanger patients to suffer from more severe and potentially fatal COVID-19. Since we are multi-faceted professionals, every aspect of our life has to adapt to the *new normal*: wearing face masks, keeping social distance, practicing strict and frequent hygiene, as well as redirecting our surgical expertise towards the ones who are more susceptible to illness.

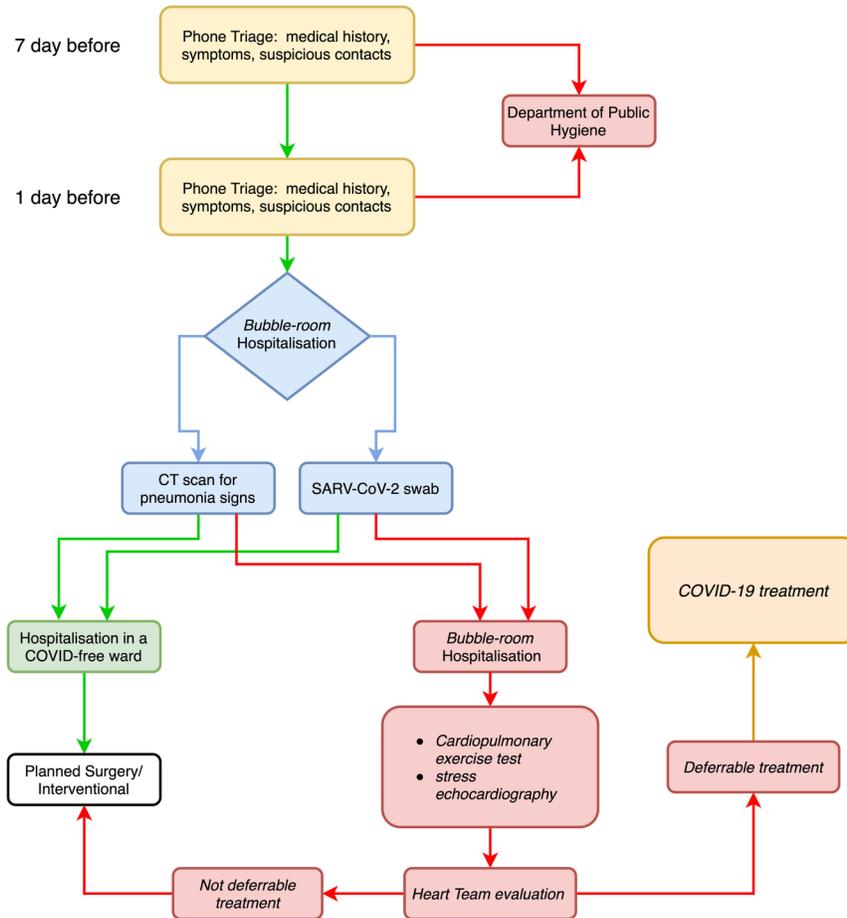


Figure 1: The flow chart we adopt to screen and treat GVM Care&Research hospital network patients safely

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