General Thoracic and Cardiovascular Surgery (2021) 69:172–174
https://doi.org/10.1007/s11748-020-01417-z

HOW TO DO IT

Congenital heart disease in the era of COVID-19 pandemic

Raffaele Giordano[1] · **Massimiliano Cantinotti**[2]

Received: 7 May 2020 / Accepted: 18 June 2020 / Published online: 22 June 2020

Abstract
The pandemic of COVID-19 presents an unprecedented challenge to identify effective prevention and treatment. Scientific literature has exploded with many news concerning the different experiences and the first studies in the world. To date May 5 2020, if we carry out a search in pubmed with the keyword "COVID-19", more than 9000 papers appear. While if we carry out a search with the keywords "congenital heart disease and COVID-19", we find only 4 results. This is a viewpoint in which we summarize the most important problems that emerged with the most recent data in the literature.

Keywords Congenital · Pediatric · Heart disease · Covid-19

The global pandemic of novel coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) began in Wuhan, China, in December 2019, and has since spread worldwide [1]. The pandemic of COVID-19 presents an unprecedented challenge to identify effective prevention and treatment. Given the rapid pace of scientific discovery and clinical data generated by the large number of people rapidly infected by SARS-CoV-2, clinicians need accurate evidence regarding effective medical treatments for this infection. Scientific literature has exploded with many news concerning the different experiences and the first studies in the world. To date May 5 2020, if we carry out a search in pubmed with the keyword "COVID-19", more than 9000 papers appear. While if we carry out a search with the keywords "congenital heart disease and COVID-19", we find only 4 results. Currently, there is no evidence from randomized clinical trials that any potential therapy improves outcomes in patients with either suspected or confirmed COVID-19 [2].

The majority of the world's population now lives in urban settings, leading to close contacts conducive to the spread of infection. Increase in life expectancy has also amplified the proportion of elderly and of individuals with chronic conditions and/or cancer, all at greater risk of infection and its sometime fatal complications.

Congenital heart disease (CHD) is the most common and global inborn defect [3]. But when we talk about CHD, a distinction must be made between the pediatric population and the adult population. While the majority of patients had rather effective surgical and/or catheter interventions in childhood, many are afflicted by residual cardiac problems. With an increasing life expectancy amongst them, grown-up congenital heart disease (GUCH) patients are susceptible to acquired cardiovascular and other comorbidities [3].

Once a patient with GUCH is diagnosed with COVID-19, the management of the infection is similar to the general population [4]. Most COVID-19 patients (close to 80% in the Chinese experience) can be managed expectantly at home with self-care measures [4].

Symptomatic relief with antipyretics, use of supplemental oxygen and management of comorbid conditions are the cornerstones of therapy. The use of antiviral, immune modulating, or antibiotic therapies is at this point not considered standard of care. Many of COVID-19 therapies have cardiovascular side effects and caution must be used when applying them to patients with CHD.

Specific data pertaining to GUCH patients and COVID-19 are currently lacking. While awaiting for the evidence, Tan and Aboulhosn propose "sensible steps" in diagnostics, risk stratification, prevention and management [5]. It stands to reason, as authors clearly point out, that GUCH patients could be considered relatively high risk for complications

✉ Raffaele Giordano
r.giordano81@libero.it

[1] Division of Adult and Pediatric Cardiac Surgery, Department of Advanced Biomedical Science, University of Naples Federico II, Via Pansini 5, 80131 Naples, Italy

[2] Tuscany Foundation G. Monasterio CNR-Regione Toscana, Massa and Pisa, Italy

from COVID-19, especially those with complex underlying cardiac defects, decreased functional reserve, and/or reduced immunity, the last being the case only in a small subset of them [5]. This is further reinforced when arrhythmias are taken into account, being de facto a common complication of GUCH and being reported as one of the main complications requiring intensive care treatment in COVID-19.

There is only limited data detailing the effects of COVID-19 on the pediatric population. A review of 72,314 cases by the Chinese Center for Disease Control and Prevention showed that 1% of COVID-19 cases were in children younger than 10 years old [4].

The mechanism by which children seem less susceptible to severe infection caused by SARS-CoV-2 has yet to be elucidated. It has been theorized that the ACE2 (the binding protein for SARS-CoV-2) in children is not as functional as it is in adults, and thus, SARS-CoV-2 is less infectious [6].

Few studies described children with CHD and COVID-19, and thus, the effect of the virus on this specific patient population is not clear. Nevertheless, children seem less vulnerable to COVID-19 than adults overall. While many segments of our society can pause during this period of crisis, CHD require continuing care, particularly amongst newborns and infants who often require surgery during a narrow window of time to avoid death and provide for optimal outcomes. Crisis management strategies for congenital heart disease have recently been published [7]. In this paper Stephens et al. deal with many aspects such as social exposure and distancing, triage, timing and role of the surgeon. We agree that social distancing can be particularly challenging for our patients, given their age and family structure. Many important the appropriate use of personal protection equipment (PPE) for healthcare workers and screening of incoming patients to prevent spread of COVID-19 within the hospital setting. In addition, asymptomatic children can be carriers and especially for younger it is difficult to keep masks and maintain social distancing. For this reason testing should be performed on every patient, even asymptomatic patients, as well as their parents. A positive test would substantially change both decision-making regarding their surgery as well as precautions taken during their hospitalization, use of limited PPE, and interaction with workers and family members. The outcomes of positive COVID-19 patients undergoing urgent and indifferent interventions are currently unknown. In this period, cooperation between surgeons and cardiologists is even more important to evaluate hospital resource utilization, clinical status of the patient and risk of delaying surgery, comorbidities and complexity of the procedure and risk of exposure for the patient, family and healthcare staff. These decisions often be made in the context of a hospital that needs to assistance for other patients from different specialties with COVID-19 infection.

In addition, Levy and colleagues try in a short communication to answer the most frequent questions for pediatric patients with CHD [8]. However, there are few established concepts: (1) the best test for SARS-CoV2 in the peri-operative setting is a PCR of respiratory secretions. Serology serum testing for antibodies (IgG) will demonstrate prior exposure (or maternal status for neonates) rather than active illness, so is less useful in a peri-operative setting [9]; (2) CT scans should not be used to screen for or diagnose pediatric COVID-19. CT scans should be reserved for other clinical indications based on symptoms; (3) ll parents entering the hospital or clinic should be screened for symptoms suggesting COVID-19 and for test screening performed routinely [9]; (4) for infants born to COVID positive mothers should be reasonable to separate him from the mother if will need cardiac surgery to try avoid post-natal infection. In fact, there is minimal evidence of placental vertical transmission. It may also be reasonable to do serial testing on the infant, but there is no consensus on the correct timing [10]; (5) surgery should be scheduled with advice from a multidisciplinary team of experts including cardiac medical, cardiac surgical, and infectious diseases as indicated. If prudent, surgery should be delayed until the patient's symptoms have improved and/or testing has been repeated (often after 14 days) and is negative [8].

As for adult management in COVID-19 infection, the use of lung ultrasound in the pediatric population could be very useful for screening and management, as already we have demonstrated in the management of children with CHD [11, 12]. The adoption of lung ultrasound to monitor lung disease during the COVID-19 outbreak may reduce the number of chest X-ray, limiting dangerous radiation cumulative exposure [12]. Lung ultrasound is an easy, cheap and fast technique that can be repeated at patient bed. While in adult setting (especially in overweight patients) image quality of lung ultrasound may be suboptimal, in the small thorax of children image quality is usually extremely high. Furthermore in the small thorax of the children, lung examination is faster and a complete and accurate examination of all lung sectors may be achieved in a few minutes.

In a recent systematic review, Sanna et al. [13] concluded that even though COVID-19 infection in childhood is less common and with milder symptoms than when occurring in adult patients, it is not without the risk of cardiac involvement, especially in the patients with a background of congenital heart disease. In newborns and children, previous cardiac surgery is related with the risk of a more severe form of the disease, being admitted to intensive care unit, and needing intubation as well as mechanical ventilation.

It is imperative that local CHD programs, in concert with national and global organizations, work together to be ready to enroll these patients in study registries and trials.

As Stephens et al. [7] have well concluded, we are a small community with a rich network of relationships. We are now trying to find ways to work together. While isolated physically, we are virtually connected and this support is vital to our success.

Funding None declared.

Compliance with ethical standards

Conflict of interest None declared.

Employment or leadership None declared.

References

1. Zhu N, Zhang D, Wang W, et al. China Novel Coronavirus Investigating and Research Team. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382(8):727–33.
2. Sanders JM, Monogue ML, Jodlowski TZ, Cutrell JB. Pharmacologic treatments for coronavirus disease 2019 (COVID-19): a review. JAMA. 2020. https://doi.org/10.1001/jama.2020.6019.
3. Brida M, Chessa M, Gu H, Gatzoulis MA. The globe on the spotlight: coronavirus disease 2019 (Covid-19). Int J Cardiol. 2020
4. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention, JAMA 2019 (2020) 3–6, [Internet]. (2020). Available from http://www.ncbi.nlm.nih.gov/pubmed/32091533.
5. Tan WM, Aboulhosn J. Coronavirus disease 2019 (COVID-19) and cardiovascular burden including congenital heart disease. Int J Cardiol. 2020. https://doi.org/10.1016/j.ijcard.2020.03.063.
6. Dong Y, Mo X, Hu Y, et al. Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. Pediatrics 16(e20200702), [Internet]. 2020. Available from: http://pediatrics.aappublications.org/lookup/doi/10.1542/peds.2020-0702.
7. Stephens EH, Dearani JA, Guleserian KJ, Overman DM, Tweddell JS, Backer CL, Romano JC, Bacha E. COVID-19: crisis management in congenital heart surgery. Ann Thorac Surg. 2020. https://doi.org/10.1016/j.athoracsur.2020.04.001 **(Epub ahead of print)**.
8. Levy E, Blumenthal J, Chiotos K, Dearani JA. COVID-19 FAQ's in pediatric cardiac surgery. World J Pediatr Congenit Heart Surg. 2020;21:2150135120924653.
9. https://www.cdc.gov/coronavirus/2019-nCoV/index.html. Accessed 25 Apr 2020.
10. Schwartz DA. An analysis of 38 pregnant women with COVID-19, their newborn infants, and maternal-fetal transmission of SARS-CoV-2: maternal coronavirus infections and pregnancy outcomes. Arch Pathol Lab Med. 2020. https://doi.org/10.5858/arpa.2020-0901-SA.
11. Cantinotti M, Giordano R, Scalese M, Marchese P, Franchi E, Viacava C, Molinaro S, Assanta N, Koestenberger M, Kutty S, Gargani L, Ait-Ali L. Prognostic value of a new lung ultrasound score to predict intensive care unit stay in pediatric cardiac surgery. Ann Thorac Surg. 2020;109(1):178–84.
12. Cantinotti M, Giordano R, Gargani M, Marchese P, Franchi E, Koestenberger M, Kutty S, Ait-Ali L, Assanta N. Could judicious use of lung ultrasound reduce radiographic examinations in pediatric cardiac surgery patients? J Clin Anesth. 2020;61:109638.
13. Sanna G, Serrau G, Bassareo PP, et al. Children's heart and COVID-19: up-to-date evidence in the form of a systematic review. Eur J Pediatr. 2020. https://doi.org/10.1007/s00431-020-03699-0.