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Impact of COVID-19 Pandemic on Organ Donation in Hong Kong: A Single-Center Observational Study

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ABSTRACT

Introduction. The coronavirus disease 2019 (COVID-19) pandemic was expected to have a negative impact on organ donation. With the differences in health care systems and lockdown policies in various regions, the pandemic’s effect on organ donation and transplant service may vary. Most of the deceased donor organ referrals in our hospital came from non-intensive care units (ICUs). The objective of this study is to report our experience and quantify the effects of the COVID-19 pandemic on deceased donor organ donation in our center.

Methods. This was a retrospective observational study comparing the deceased donor organ donation activity during the period January 23 to November 30, 2020 with the same period in 2018 in Queen Elizabeth Hospital, Hong Kong.

Results. There was a 26.9% reduction in deceased donor organ donor referral in 2020 compared with 2018. No significant difference in the proportion of referrals from ICU or non-ICU areas between the 2 time periods was observed. The brain death confirmation rate was significantly higher in 2020 (40.8% vs 20.2%, \( P = .003 \)). Nine patients had family consent for organ donation in 2020 (vs 7 patients in the same period in 2018). There were no significant differences in consent rate and number of recovered organs between the 2 periods.

Conclusions. With effective measures to limit the spread of COVID-19 in a community, it is possible to support the needs of both patients with COVID-19 and deceased donor organ donation services.
health measures, including increased border control, suspension of schools, and working from home requirements for civil servants. In the hospital setting, new visiting arrangements and adjustments for non-emergency medical service were implemented in an attempt to reduce crowding in hospital areas and minimize the regional spread of the disease. Living donor donation programs were temporarily suspended and deceased donor organ procurement and transplantation were maintained.

Because the challenges presented by COVID-19 are unprecedented, there are no standard practices or guidelines for how to deal with the various issues encountered in the organ donation and transplantation setting. Given the differences in health care systems and lockdown policies in various regions, notable differences have been observed in the regulation of organ donation and transplant services during the COVID-19 pandemic. As a result, it will be useful to learn how COVID-19 has affected organ donation in different parts of the world. There have been few studies investigating the impact of COVID-19 at the transplant center level.

In addition to being the largest regional hospital in Hong Kong, Queen Elizabeth Hospital is 1 of the 4 major kidney transplant centers and contributes approximately one-third of all deceased donors in this region. All deceased donors in our center are brain-dead donors. Patients can receive mechanical ventilation in general wards and more than 70% of organ donors are from non-ICU units [7]. Kidney transplant recipients receive postoperative care in the transplant ward. Compared with the overall organ donation statistics for all hospitals in Hong Kong, more deceased organ donor referrals were from non-ICU units in our hospital. In addition, all possible brain-dead donors in our center were referred early to the organ donation coordinators (ODCs) for evaluation. This might explain the lower brain death confirmation rate and family consent rate in our center when compared with other hospitals in our region [7,8]. The objective of this study is to report our experience and quantify the effects of the COVID-19 pandemic on deceased donor organ donation in our center.

MATERIAL AND METHODS

This was a retrospective observational study comparing the deceased donor organ donation activity during the period January 23 to November 30, 2020 with the same period in 2018 at Queen Elizabeth Hospital, Hong Kong. The year 2019 was not chosen for comparison because of the social unrest in Hong Kong, which might have affected organ donation activities. Organ donation information including age, sex, cause of death, referral department, and final outcome of all referrals received by the ODCs can be obtained from the Organ Procurement System, an online registry system developed by the Central Renal Committee, Hospital Authority. The study was approved by the Kowloon Central Cluster Research Ethics Committee (Reference No. KC/KE-20-0309/ER3) and was carried out according to the Declaration of Helsinki. Informed consent was waived because of the retrospective nature of the analysis.

Statistical analyses were performed using SPSS version 23.0 (SPSS; IBM Corp, Chicago, IL, USA). Categorical data are expressed as percentages and were compared with \( \chi^2 \) or Fisher exact tests and continuous data are expressed as means and standard deviations and were compared with \( t \) tests. All tests were 2-tailed, and \( P \) values \( \leq .05 \) were considered significant.

RESULTS

All organ donors and recipients were screened for epidemiologic history and COVID-19 symptoms. Because of the possibility of asymptomatic carriers and transmission during organ procurement and transplantation, SARS-CoV-2 reverse transcriptase polymerase chain reaction testing of all deceased organ donors was performed by either nasopharyngeal aspirate, nasopharyngeal swab, or tracheal aspirate. Starting in May, SARS-CoV-2 testing was also performed for all transplant recipients before transplantation. Results for all donors and recipients who underwent pretransplant SARS-CoV-2 testing were negative. At the time of writing, no transplant recipients have developed post-transplant COVID-19. When compared with 2018, there was a 26.9% reduction in the number of deceased organ donor referrals received by our ODCs in 2020 (Table 1). However, there was no significant difference in the proportion of referrals from ICU or non-ICU areas between these 2 periods (\( P = .75 \)). The brain death confirmation rate was significantly higher in 2020 (40.8% vs 20.2%, \( P = .003 \)). Our ODCs approached family members of all brain-dead patients face-to-face. Family consent for organ donation was obtained for 9 patients during the COVID-19 period studied vs 7 patients in the same period in 2018. The consent rate was similar between these 2 periods (9 of 31 [29%] vs 7 of 21 [33.3%], \( P = .74 \)). There were also no significant differences in sex, age, cause of death, and number of organs recovered from deceased organ donors between the 2 periods (Table 2). All graft kidneys had immediate function after transplant in both periods.

DISCUSSION

The emergence of COVID-19 has placed a huge burden on the health care infrastructure in many areas, especially in regions with widespread community transmission and limited resources. The lack of ICU beds available for both organ donors and transplant recipients has a negative impact on the overall donation activity, which has led to a reduced number of transplants. Whereas living donor organ donation can be rescheduled, deceased donor organs must be procured immediately. In April 2020, the overall reduction in deceased donor transplants since the COVID-19 outbreak was 90.6% in France and 51.1% in the United States [1]. In the United Kingdom, the number of deceased donors decreased by 66% during the lockdown period (March 23 to May 10, 2020) compared with the same period in 2019 [2]. On the other hand, COVID-19 had no significant effect on the number of deceased organ donors in Slovenia and

| Number of Deceased Donor Organ Donor Referrals | 2018 n = 104 | 2020 n = 76 | \( P \) Value |
|-----------------------------------------------|--------------|-------------|------------|
| Referral department                            |              |             |            |
| ICU                                           | 14 (13.5)    | 9 (11.8)    | 0.75       |
| Non-ICU                                       | 90 (86.5)    | 67 (88.2)   | 0.003      |
| Brain death confirmation                      | 21 (20.2)    | 31 (40.8)   |            |

Categorical data are expressed as n (%) and were compared with \( \chi^2 \) or Fisher exact tests.

ICU, intensive care unit.
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were already brain dead. This could explain the lower organ decrease. Our medical staff tended to refer potential organ COVID-19, donor awareness among medical staff may same time period in 2018. With more attention placed on ily consent rate during the COVID-19 era compared with the lion population among developed regions. This is important cases at the time of writing, which is 1 of the lowest per mil-2 million deaths globally, Hong Kong has approximately 9500 negative impacts on the brain death con...reduced number of deceased donor referrals, there were no donors are from ICUs. Our study shows that even with the overwhelming as in other regions where more than 90% of deceased donor organ donations and transplants can be main-5.8 55.1 ± 3.9  .65

| Cause of death                  | 2018 n = 7 | 2020 n = 9 | P Value |
|--------------------------------|------------|------------|---------|
| Cerebrovascular accident       | 6 (85.7)   | 7 (77.8)   |         |
| Head trauma                    | 1 (14.3)   | 2 (22.2)   |         |
| Recovered organs               | 16         | 16         | 1       |
| Kidney                         | 7          | 7          |         |
| Liver                          | 5          | 5          |         |
| Lung                           | 3          | 3          |         |
| Heart                          | 1          | 1          |         |

Categorical data are expressed as n (%) and were compared with χ² or Fisher exact tests. Continuous data are expressed as mean values ± standard deviations and were compared with t tests.

Table 2. Deceased Organ Donors in 2018 and 2020

Germany. This could be related to the effectiveness of strict nationwide preventive measures and control strategies against the infection [9,10].

Hong Kong SAR is one of the most densely populated areas in the world, with a population of more than 7.4 million. As an international travel hub, more than 70 million people pass through Hong Kong every year. Despite this, Hong Kong has a relatively low number of COVID-19 cases. This can be attributed to public health measures, including standard border control, social distancing, case detection by high-volume testing for SARS-CoV-2, aggressive contact tracing, and supported quarantine of close contacts. In addition, personal protective behaviors, including universal use of face masks and hand hygiene by people living in Hong Kong, have played a significant role in controlling the spread of COVID-19 in our region [11]. Despite over 93 million COVID-19 cases and 2 million deaths globally, Hong Kong has approximately 9500 cases at the time of writing, which is 1 of the lowest per million population among developed regions. This is important because overloading hospitals with patients with COVID-19 will hinder hospitals’ ability to handle acute, non—COVID-19 services such as organ donation and transplantation. In Hong Kong, although combating COVID-19 remains the priority, deceased donor organ donations and transplants can be maintained. In addition, because nearly 90% of deceased organ donors are referred and supported in non-ICU areas in our hospital, the effect of COVID-19 on organ donation may not be as overwhelming as in other regions where more than 90% of donors are from ICUs. Our study shows that even with the reduced number of deceased donor referrals, there were no negative impacts on the brain death confirmation rate and family consent rate during the COVID-19 era compared with the same time period in 2018. With more attention placed on COVID-19, donor awareness among medical staff may decrease. Our medical staff tended to refer potential organ donors to our ODCs at a later stage and a higher proportion were already brain dead. This could explain the lower organ donor referral but higher brain death confirmation rate during COVID-19 in this study. Despite the limitations on family visits to the hospital because of quarantine rules, our ODCs had the opportunity to have face-to-face discussions with family members regarding organ donation once the brain death was established. The engagement between family and ODCs in the donation process explains the similar family consent rate during the COVID-19 pandemic.

Because of the varied effects of the COVID-19 pandemic on different regions, Kumar et al proposed a phased approach to reducing organ donation and transplant activity with particular consideration of the COVID-19 patient load and the amount of health care resources, including hospital capacity, availability of personal protective equipment, and manpower [4]. Better control of COVID-19 can allow more rapid recovery of organ donation and transplant activities.

CONCLUSION

Hong Kong has been dealing with the spread of COVID-19 since early in the pandemic with rapid implementation of a number of restrictive measures that effectively limited the mass outbreak of disease. So far, COVID-19 has had only a minimal effect on our overall organ donation activity. Our current study shows that with effective measures to limit the spread of COVID-19 in a community, it is possible to support the needs of both patients with COVID-19 and deceased donor organ donation services.

DATA AVAILABILITY

Data will be made available on request.

REFERENCES

[1] Loupy A, Aubert O, Reese PP, Bastien O, Bayer F, Jacquelinet C. Organ procurement and transplantation during the COVID-19 pandemic. Lancet 2020;395:e95–6.
[2] Manara AR, Mumford L, Callaghan CI, Ravanan R, Gardiner D. Donation and transplantation activity in the UK during the COVID-19 lockdown. Lancet 2020;396:465–6.
[3] de Vries APJ, Alwayn IPJ, Hoek RAS, et al. Immediate impact of COVID-19 on transplant activity in the Netherlands. Transpl Immunol 2020;61:101304.
[4] Kumar D, Manuel O, Natori Y, et al. COVID-19: a global transplant perspective on successfully navigating a pandemic. Am J Transplant 2020;20:1773–9.
[5] Angelico R, Trapani S, Manzia TM, Lombardini L, Tison G, Cardillo M. The COVID-19 outbreak in Italy: initial implications for organ transplantation programs. Am J Transplant 2020;20:1780–4.
[6] International Registry in Organ Donation and Transplantation. Transplant procurement management. <http://www.irodat.org> ; 2020 [accessed 09.09.20].
[7] Cheung CY, Pong ML, Au Yeung SF, Chau KF. Factors affecting the deceased organ donation rate in the Chinese community: an audit of hospital medical records in Hong Kong. Hong Kong Med J 2016;22:570–5.
[8] Tong YF, Koo J, Cheng B. Review of organ donation in Hong Kong: 1996–2009. Hong Kong J Nephrol 2010;12:62–73.
[9] Arnoł M, Smržič L, Avsec D, Gadižije A, Knežević I. An increase in kidney transplantation procedures from deceased donors during the COVID-19 epidemic in Slovenia. Transpl Int 2020;33:1562–4.
[10] Qu Z, Oedingen C, Bartling T, Schrem H, Krauth C. Organ procurement and transplantation in Germany during the COVID-19 pandemic. Lancet 2020;396:1395.
[11] Wong SYS, Kwok KO, Chan FKL. What can countries learn from Hong Kong’s response to the COVID-19 pandemic? CMAJ. 2020;192:E511–5.