



# Protocol to ensure continued pediatric liver transplantation service during the COVID pandemic and the encouraging outcomes

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## Abstract

Coronavirus disease 2019 is a global pandemic, and to deal with the unexpected, enormous burden on healthcare system, liver transplantation (LT) services have been suspended in many centers. Development of robust and successful protocols in preventing the disease among the recipients, donors and healthcare workers would help in re-starting the LT programs. We adapted a protocol at our center, which is predominantly a living donor liver transplant center based in north India, and continued the service as the pandemic unfolded and peaked in India with good results and shared the experience of the same. Between March 24 and June 7, 2020, during the government-enforced public curfew—"lockdown"—7 children received LT. The protocols of infection control were drafted in our team by local customization of published guidelines. The number of pediatric LT done during the lockdown period in 2020 was similar to that done in corresponding pre-COVID period in 2019. The outcomes were of 100% survival, and none of recipients developed COVID. One potential donor was asymptomatic positive for COVID, responded well to conservative treatment, and was later accepted as a donor. LT program during the COVID pandemic can successfully function after putting in place standard protocols for infection control. These can be implemented with minimal extra involvement of healthcare infrastructure, hence without diversion of resources from COVID management. In conclusion, pediatric liver transplantation services can be continued amid COVID-19 pandemic after establishing a properly observed protocol with minimum additional resources.

## KEYWORDS

cholestasis, chronic liver disease, living donor, pandemic, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

## 1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) is a global pandemic.<sup>1,2</sup> The enormity of the disease spread and severity is unprecedented, placing the healthcare system under enormous stress.<sup>3</sup> In India, the first documented case of COVID-19 was on January 30, 2020.<sup>4</sup> By June 16, 2020, that is, in less than 6 months, 354 065 individuals have tested positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) of which 11 903 patients died.<sup>4</sup> In response to the pandemic, the government had placed a “nationwide lockdown” between the March 24 and June 1, 2020, wherein a public curfew was placed, and except essential services, all activities were ceased. The UN, WHO, and the Oxford COVID-19 Government Response Tracker (OxCGRT) evaluated the government response as adequate and robust.<sup>5</sup> During the lockdown period, the directive was to build capacity of hospitals and limit the community spread. The rationale was the experience of various countries affected before India wherein increasing numbers of the affected individuals requiring hospital care had overwhelmed the ability of the hospitals to provide care to non-COVID-19 patients.<sup>6</sup> In this context, maintaining a pediatric living donor liver transplant (LDLT) is a complex decision. The aspects related to this are as follows: keeping dedicated ICU bed availability, donor and recipient management, healthcare provider safety, and most pertinently the need for continuation of the program.<sup>7-9</sup>

Based on the guidelines from AASLD and national transplant society (LTSI), data from European transplant centers, we decided to follow stringent infection control practices and continue the pediatric LT program.<sup>10-12</sup> In this manuscript, we describe our protocols and

experience of having performed LDLT for 7 children since the start of the “lockdown,” that is, between April 1 and June 15 (2.5 months), as the pandemic unfolded across India. This information would be useful for continuation of safe pediatric LT programs worldwide.

## 2 | PATIENTS AND METHODS

### 2.1 | Duration of inclusion

The study period included was from the start of nationwide lockdown for the COVID pandemic, till one week after end of lockdown, that is, from March 24 to June 7, 2020.

### 2.2 | Case selection

Elective liver transplants were suspended in this duration, and only urgent cases were listed. Details of indications are described in Results section (Table 1). Liver transplant was considered as an urgent life-saving procedure when ALF King's College criteria were met or when biliary atresia was present; then, acute decompensation was taken as indication.

Only living donor liver transplants were carried out during this period. The National Organ and Tissue Transplant Organization officially declared for deceased donor liver transplants to stop throughout the country during the lockdown period.

Ethics committee approval was waived as it was retrospective study of existing data in the electronic record monitoring.

S. No	Age / weight / gender	Indication of LT	Primary liver disease	Donor
1	180 months / 50 Kg / male	Acute liver failure	Hereditary hemorrhagic telangiectasia type 2	Mother
2	17 months / 12 Kg / male	Completion of chemotherapy	Hepatoblastoma	Mother
3	25 months / 10.5 Kg / male	Hepatic encephalopathy	Biliary atresia	Uncle
4	9 months / 9.6 Kg / female	Upper GI bleeding	Congenital bile acid synthesis defect type 3	Mother
5	144 months / 45 Kg / female	Coagulopathy	ACLF	Elder sibling
6	12 months / 7.5 Kg / Female	Hepatic encephalopathy	Biliary atresia	Father
7	6 months / 5.2 Kg / Female	Coagulopathy	Biliary atresia	Mother

TABLE 1 Cohort description

## 2.3 | Hospital and unit–safety protocol

One building of our hospital has been identified as a COVID treatment facility, which is physically and functionally separate from the building that houses our transplant program in its entirety. The protocol of COVID infection control followed in our unit followed the following sequential steps:

1. In the pre-LT duration
2. Notification to family that there will be prohibition of visitor access during hospital stay.
3. One family member, in addition to the donor and recipient, would also be admitted to provide support to both.
4. COVID screening of donor and recipient for exposure, clinical symptoms and RT-PCR on nasopharyngeal swab, except in case of inter-hospital transfer for ALF.
5. Admission to the transplant ICU in single-bed cabin with 1:1 nursing ratio.
6. Pre-LT workup completed with minimal movement within the hospital by clubbing of radiological investigations and minimizing exposure periods outside the ICU.
7. As the cases were done during lockdown period, they were in isolation for a minimum of 14 days before COVID swab was obtained. COVID samples were taken immediately before admission.
8. Prior approval from blood bank was taken in order to ensure adequate supply of blood and blood products in peri-operative period.
9. During the LT surgery
10. All our team members were also tested for SARS-CoV-2 before initiation of LDLT, and only those who were negative were part of the OR team.
11. Standard protocols for minimal aerosol generation were followed.
12. Extubation done in the operating room, prior to ICU transfer.
13. Efforts to limit blood loss were taken, and only a senior surgeon performed the liver explants during this period.
14. Post-LT surgery duration
15. Regular immune-suppression regime was followed, including steroid, MMF, and tacrolimus.
16. Single-bed ICU rooms were used to house the children in this duration.
17. Nursing practices: 1:1 nursing care, strict hand, and food hygiene.
18. Doctor rounds—minimal personnel and frequency to enter ICU rooms, all multidisciplinary discussions were done non-bedside and remotely.
19. Prolonged ICU stay to minimize interaction with others, which happens in the ward.
20. Direct discharge to home from ICU.
21. Considering increased risk of contracting COVID secondary to immunosuppression proper isolation was followed during inpatient period, and attendants were clearly advised to practice the same after discharge.

## 3 | RESULTS

### 3.1 | Cohort description

7 children underwent LDLT in this duration. The mean age and weight of recipients at time of LT were 56 months (6–180 months) and 20 Kg (5.2–50 Kg). The organ donor was mother for 4; father, elder sibling, and uncle for 1 each (Table 1).

### 3.2 | Comparison with non-COVID lockdown cohort in same duration in 2019

The comparison of basic cohort characteristics in the corresponding duration in 2019 (from March 24 to June 7) is outlined in Table 2. We observed that the number of pediatric liver transplants did not decrease in the “lockdown” duration. Expectedly, as per the change in the protocol, the duration of hospital stay was 45% longer (10 days).

### 3.3 | COVID characteristics pre-LT

1. All recipients tested negative for COVID in pre-LT duration, and none had any symptoms compatible with COVID infection (Table 3).
2. Donor for patient 6 tested positive on RT-PCR for COVID, while being asymptomatic. She was placed in quarantine as per government policy. The repeat screening done at 14 days post-quarantine, and pre-LT was negative. She never developed any symptoms, and the other family members remained negative. All other donors were asymptomatic and also negative on RT-PCR screening pre-LT.
3. All transplant team members tested in this duration found to be clinically asymptomatic and negative on RT-PCR screening.

### 3.4 | COVID characteristics post-LT

None of the recipients, donors, or healthcare providers involved in care developed any symptoms suggestive of COVID. All recipients continued to stay in the ICU / HDU till discharge, continued to be provided by 1:1 nursing care, and were subjected to minimal interactions, as per pre-decided protocol described in methods.

TABLE 2 Comparison of same duration in COVID (2020) and non-COVID era (2019)

	March 24- June 7, 2020	March 24, 2018- June 7, 2019
Number of children receiving LT	7	8
Mean age	56 (6–180)	38.8 (11–132)
Median age	17	20
Mean weight	20 (5.2–50)	11.4 (5–23)
Median weight	10.5	13
Duration of hospital stay post-LT	32 days	22 days

TABLE 3 COVID screening details

Patient S. No	Pre-LT donor COVID screening	Pre-LT recipient COVID screening
1	Negative	Negative
2	Negative	Negative
3	Negative	Negative
4	Negative	Negative
5	Positive then negative	Negative
6	Negative	Negative
7	Negative	Negative

## 4 | DISCUSSION

Our positive experience of sustaining the pediatric LT program while the COVID pandemic unfolded and the government enforced curfew "lockdown" is reassuring. This also gives us a blueprint to follow as SARS-CoV-2 will not suddenly cease to exist, though countries emerge from the crisis and "open up." The uneventful recovery of a transplant recipient child from the COVID infection as described by Fabre et al further instils confidence in pursuing this strategy.<sup>13</sup> In contrast, the Netherlands suffered the consequences of shutting down the pediatric LT program.<sup>12</sup> The AASLD guidelines too have suggested to continue the transplant serves for children but emphasized for ALF conditions.<sup>10</sup> The impact of COVID on cholestatic conditions is unknown, though the adverse impact on CLD is predicted. Our experience suggests that planned LT should be continued unhindered for children while observing the mandatory precautions. While observing the protocol as outlined in Methods section, we could avoid any COVID infections in the donors, recipients, and among the healthcare providers. The continuation of the transplant with the donor who had recovered for the infection was well debated in our team and shown to be suitable. By following these steps, we can avoid unnecessary repeated testing and PPE consumption, allay fear in providing the LT services for children, and minimize the utilization of the resources needed for battling the COVID pandemic as well.

In conclusion, we observed that well-planned protocols and procedures can permit the continuation of pediatric LT services, and these need to be adhered to in foreseeable future as well, given that COVID infection will not abruptly cease.

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### CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

### AUTHOR CONTRIBUTION

Sharat Varma contributed to conceptualization, writing the original draft, and writing, reviewing, and editing of the manuscript. Yuktansh Pandey, Bharwagawa R Chikkala, Rajgopal Acharya, Sapana Verma,

Inbaarj B, Dibyajyoti Das, and Rajesh Dey wrote, reviewed, and edited the manuscript. Sreejith Sreekumar reviewed and edited the manuscript. Shaleen Agarwal and Subhash Gupta contributed to conceptualization, supervision, and writing, reviewing, and editing of the manuscript.

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### REFERENCES

- Fauci AS, Lane HC, Redfield RR. Covid-19 navigating the uncharted. *N Engl J Med*. 2020;382(13):1268-1269.
- Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. 2020;382:1708-1720.
- Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of Covid-19. *N Engl J Med*. 2020;382(21):2049-2055.
- Home Ministry of Health and Family Welfare GOI. <https://www.mohfw.gov.in/> - mohfw.gov.in."Home | Ministry of Health and Family Welfare | GOI". <https://www.mohfw.gov.in/> - mohfw.gov.in."Home | Ministry of Health and Family Welfare | GOI". <https://www.mohfw.gov.in/> - mohfw.gov.in. Retrieved 25 June 2020.
- Sharma S. "Lockdown in India was early, far-sighted and courageous": WHO envoy"; 2020. Hindustan Times. Retrieved 3 April 2020.
- "India's response to COVID outbreak". Press Information Bureau. 28 March 2020. Retrieved 4 April 2020.
- Kumar D, Manuel O, Natori Y, et al. COVID-19: a global transplant perspective on successfully navigating a pandemic. *Am J Transplant*. 2020;20(7):1773-1779.
- Martino F, Plebani M, Ronco C. Kidney transplant programmes during the COVID-19 pandemic. *Lancet Respir Med*. 2020;8(5):e39. [https://doi.org/10.1016/S2213-2600\(20\)30182-X](https://doi.org/10.1016/S2213-2600(20)30182-X).
- Global Transplantation Covid Report. [https://tts.org/index.php?option=com\\_content&view=article&id=696&Itemid=115](https://tts.org/index.php?option=com_content&view=article&id=696&Itemid=115), 2020.
- Fix O, Hameed B, Fontana RJ, et al. Clinical best practice advice for hepatology and liver transplant providers during the COVID-19 pandemic: AASLD expert panel consensus statement. *Hepatology*. 2020;72:287-304. <https://www.aasld.org/about-aasld/covid-19-resources>.
- Saigal S, Gupta S, Sudhindran S, et al. Liver transplantation and COVID-19 (Coronavirus) infection: guidelines of the liver transplant Society of India (LTSI). *Hepatol Int*. 2020;14(4):429-431. <https://doi.org/10.1007/s12072-020-10041-1>.
- de Vries APJ, Alwayn IPJ, Hoek R, et al. van den Berg, et al. van den Berg Immediate impact of COVID-19 on transplant activity in the Netherlands. *Transpl Immunol*. 2020;61:101304. <https://doi.org/10.1016/j.trim.2020.101304>.
- Morand A, Roquelaure B, Colson P, et al. Child with liver transplant recovers from COVID-19 infection. A case report. *Arch Pe 'diatr*. 2020;27(5):275-276. <https://doi.org/10.1016/j.arcped.2020.05.004>.

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