Dengue virus infection among renal transplant recipients in Singapore: a 15-year, single-centre retrospective review

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Abstract

Introduction: Dengue is a mosquito-borne viral infection endemic in Singapore. Its impact on renal transplantation is limited to small case series. We aimed to characterise the clinical presentation and outcomes of dengue infection among renal transplant recipients in Singapore.

Methods: We conducted a 15-year retrospective review of dengue in renal transplant patients treated at Singapore General Hospital between January 2005 and October 2019. The diagnosis of dengue was made if there were a compatible clinical syndrome and a positive dengue diagnostic assay (dengue non-structural 1 antigen, immunoglobulin M or reverse transcriptase-polymerase chain reaction).

Results: Of the 31 patients diagnosed with dengue, 18 (58.1%) were deceased donor recipients. The median age was 52 (interquartile range [IQR] 40–61) years; 16 (51.6%) were females. The median time to diagnosis was 99 (IQR 18–169) months from transplant. The most common clinical symptoms were fever (87.1%), myalgia (41.9%), gastrointestinal symptoms (38.7%) and headache (25.8%). Nineteen (61.3%) patients had dengue without warning signs, nine (29.0%) had dengue with warning signs, three (9.7%) had severe dengue and 30 (96.8%) were hospitalised. Seventeen (54.8%) patients had graft dysfunction, 16 (94.1%) of whom had recovery of graft function. One (3.2%) patient required dialysis and subsequently died. There were two cases of donor-derived infections (DDIs) with favourable outcomes.

Conclusion: Our experience with dengue in renal transplant recipients is concordant with published data. Although graft dysfunction is common, it is often transient with favourable outcomes. Outpatient management may be considered for mild infections. Although dengue DDIs are uncommon, more stringent donor screening may be considered in endemic regions.

Keywords: Dengue, renal transplant, Singapore

INTRODUCTION

Dengue is a mosquito-borne viral infection endemic in Singapore, and it is transmitted most commonly by the Aedes aegypti mosquito. Dengue virus (DENV) is a flavivirus with four distinct DENV serotypes (DENV-1–4), and infection with any of the serotypes can result in clinical manifestations ranging from dengue fever with or without warning signs to severe infections with plasma leakage, haemorrhage and organ impairment.[1] The Aedes mosquitoes are abundant in tropical countries,[2] and dengue is an ongoing problem in Singapore, with dengue outbreaks occurring in 5–6-year cycles.[3] In 2020, Singapore saw the highest number of dengue cases recorded, with 35,315 notified cases.[4]

Although dengue is relatively uncommon in renal transplantation[5,6] and published reports based on small case series have suggested favourable outcomes in renal transplant recipients, it is still important to understand its impact and clinical outcomes in our patients, given that dengue is endemic in Singapore and our renal transplant programme is growing. Since the inception of the renal transplant programme in
Singapore in 1970, the number of renal transplant recipients has increased over the years. In 2009, there were 359 renal transplant recipients per million population, and this increased to 400 per million population in 2018.[1] In this study, we aimed to characterise the clinical presentation and outcome of dengue infection in renal transplant recipients treated at a tertiary centre in Singapore and to corroborate our findings with international data, so as to further guide and improve our clinical management.

METHODS

We conducted a 15-year retrospective review of dengue infection in renal transplant patients treated at Singapore General Hospital between January 2005 and October 2019. The study was approved by the ethics committee of the institution (CIRB Ref: 2019/2764). All renal transplant patients who were on follow-up at our centre with dengue infection — as defined by a compatible syndrome and confirmatory laboratory tests (dengue non-structural 1 antigen, immunoglobulin M [IgM] or reverse transcriptase-polymerase chain reaction [RT-PCR] positive) — were included in the study. Renal transplant recipients with positive dengue diagnostic tests performed during the study period were identified using the SingHealth electronic health intelligence systems. Their medical records were reviewed by two investigators. Patients who had isolated positive dengue IgM serology without any clinical features of dengue were excluded from the study.

Patients were classified according to the World Health Organization (WHO) dengue classification 2009.[1] Patient demographics, transplant details, dengue clinical features, laboratory findings and clinical outcomes of dengue infections were extracted. Categorical variables were presented as absolute numbers with percentages, and continuous variables were presented as median values with interquartile ranges (IQR).

RESULTS

Thirty-one renal transplant patients were diagnosed with dengue during the study period. Patient demographics are presented in Table 1. The median age at the time of diagnosis was 52 (IQR 40–61) years, and 16 (51.6%) were females. The most common clinical symptoms were fever (87.1%), myalgia (41.9%), gastrointestinal symptoms (38.7%) and headache (25.8%); mucosal bleeding (9.7%), arthralgia (9.7%) and rash (6.5%) were uncommon. Based on the WHO 2009 dengue classification,[1] 19 (61.3%) patients had dengue without warning signs, nine (29.0%) had dengue with warning signs and three (9.7%) had severe dengue. Of the nine patients who had dengue with warning signs, two had pleural effusion, three had mucosal bleeding with epistaxis and haematuria, and the remaining four patients had lethargy with laboratory features of increased haematocrit with concurrent rapid decrease in platelet counts. Of the three patients with severe dengue, two had plasma leakage leading to shock or respiratory distress and one had multi-organ failure [Tables 2 and 3]. The median duration of clinical illness was 7 (IQR 6–7) days. Most of the patients were managed in the hospital; 30 (96.8%) patients were admitted. The median length of hospital stay was 8 (IQR 6–13) days. Majority (96.8%) of our patients were presumed to have primary infection, as dengue IgG serology was not routinely done. Only one patient in our series was tested for and had a negative dengue IgG serology, and this patient was confirmed to have primary dengue infection.

All patients were on immunosuppressive therapy at the time of dengue diagnosis, with a combination of prednisolone, mycophenolate mofetil (MMF)/mycophenolic acid (MYF) and tacrolimus being the most common immunosuppressive regimen. Of the 25 patients who were on antimetabolite immunosuppressant (MMF/MYF/azathioprine), 11 (44.0%) discontinued their immunosuppressant and five (20.0%) had reduced doses of immunosuppressant during the episode of dengue due to leucopenia, thrombocytopenia or deranged liver function tests. Of these 16 patients who had their doses discontinued or reduced, 11 (68.8%) were restarted back on full dose of antimetabolite immunosuppressant within 2 weeks of discharge, upon recovery of their cell counts. There were 26 patients who were on calcineurin inhibitors, of whom nine (34.6%) had their doses adjusted based on

| Table 1. Patient demographics. |
|--------------------------------|
| Characteristic                | n (%) |
| Age (yr)                      | 52 (40–61) |
| Gender                        |        |
| Female                        | 16 (51.6) |
| Male                          | 15 (48.4) |
| Ethnicity                     |        |
| Chinese                       | 21 (67.7) |
| Malay                         | 8 (25.8)  |
| Indian                        | 2 (6.5)   |
| Others                        | 0 (0)    |
| Type of kidney transplant     |        |
| Deceased donor                | 18 (58.1) |
| Living donor                  | 13 (41.9) |
| Immunosuppression therapy at the time of dengue diagnosis |
| Pred + MMF/MYF + FK           | 12 (38.7) |
| Pred + MMF/MYF + CsA          | 4 (12.9)  |
| Pred + Aza + CsA              | 4 (12.9)  |
| Pred + CsA                    | 4 (12.9)  |
| Pred + MMF/MYF + SIR          | 2 (6.5)   |
| Pred + FK                     | 2 (6.5)   |
| Pred + Aza                    | 1 (3.2)   |
| Pred + ERL                    | 1 (3.2)   |
| Pred + Aza + SIR              | 1 (3.2)   |

*Data presented as median (interquartile range). Aza: azathioprine, CsA: cyclosporine, ERL: everolimus, FK: tacrolimus, MMF: mycophenolate mofetil, MYF: mycophenolic acid, Pred: prednisolone, SIR: sirolimus.*
Table 2. Clinical characteristics of all 31 kidney transplant patients with dengue infection.

| Age (yr)/gender | Gender | Confirmatory lab method | Year of diagnosis | Time from transplant (mth) | Duration of clinical illness (day) | Clinical manifestations | Coinfection | WHO classification | Graft dysfunction | Outcome |
|-----------------|--------|--------------------------|-------------------|---------------------------|-----------------------------------|----------------------------|--------------|-------------------|-------------------|---------|
| 1 34/M          | M      | NS1 Neg RT-PCR           | 2005              | 89                        | 5                                 | Fever, headache, myalgia   | Nil          | DF                | No                | Recovered |
| 2 58/F          | M      | NS1 Neg RT-PCR           | 2005              | 108                       | 9                                 | Fever, headache            | UTI          | DF                | Yes               | Recovered |
| 3 50/F          | M      | NS1 Neg RT-PCR           | 2005              | 12                        | 8                                 | Fever                    | Nil          | DF with WS        | No                | Recovered |
| 4 55/F          | M      | NS1 Neg RT-PCR           | 2005              | 2                         | 8                                 | Lethargy, haematuria       | Nil          | DF with WS        | Yes               | Recovered |
| 5 65/F          | M      | NS1 Neg RT-PCR           | 2006              | 186                       | 7                                 | Fever, vomiting, giddiness, dyspnoea | HAP          | SD                | Yes               | Demised |
| 6 52/F          | F      | NS1 Neg RT-PCR           | 2008              | 269                       | 7                                 | Fever, myalgia, lethargy, vomiting, diarrhoea, rash, poor appetite | Nil          | DF with WS        | Yes               | Recovered |
| 7 61/M          | M      | NS1 Neg RT-PCR           | 2008              | 101                       | 7                                 | Fever, dyspnoea, oliguria, abdominal pain | CAP          | SD                | Yes               | Recovered |
| 8 61/F          | M      | NS1 Neg RT-PCR           | 2009              | 22                        | 6                                 | Fever, myalgia             | UTI          | DF                | Yes               | Recovered |
| 9 58/M          | M      | NS1 Neg RT-PCR           | 2009              | 169                       | 5                                 | Fever, diarrhoea           | Nil          | DF with WS        | Yes               | Recovered |
| 10 34/F         | M      | NS1 Neg RT-PCR           | 2011              | 31                        | 6                                 | Fever, diarrhoea, headache, lethargy | Nil          | DF with WS        | No                | Recovered |
| 11 50/F         | M      | NS1 Neg RT-PCR           | 2011              | 92                        | 8                                 | Fever, myalgia, productive sputum | Nil          | DF                | Yes               | Recovered |
| 12 36/F         | M      | NS1 Neg RT-PCR           | 2011              | 215                       | 8                                 | Fever, diarrhoea           | GE           | DF                | Yes               | Recovered |
| 13 57/F         | M      | NS1 Neg RT-PCR           | 2012              | 64                        | 6                                 | Fever, dysuria, vomiting   | UTI, CMV reactivation | DF          | Yes               | Yes               | Recovered |
| 14 52/F         | F      | NS1 Neg RT-PCR           | 2013              | 50                        | 8                                 | Fever, myalgia, headache   | Nil          | DF                | Yes               | Recovered |
| 15 39/M         | M      | NS1 Neg RT-PCR           | 2013              | 61                        | 7                                 | Fever, back pain, arthralgia, headache, poor appetite | Nil          | DF                | No                | Recovered |
| 16 37/M         | M      | NS1 Neg RT-PCR           | 2013              | 139                       | 7                                 | Fever, rash                | Nil          | DF                | No                | Recovered |
| 17 52/F         | M      | NS1 Neg RT-PCR           | 2014              | 99                        | 6                                 | Fever, myalgia, headache   | UTI          | DF                | Yes               | Recovered |
| 18 53/M         | M      | NS1 Neg RT-PCR           | 2014              | 99                        | 7                                 | Fever, diarrhoea, cough, epistaxis | CAP          | DF with WS        | Yes               | Recovered |
| 19 60/F         | M      | NS1 Neg RT-PCR           | 2015              | 262                       | 7                                 | Fever, sore throat, blocked nose | Nil          | DF                | No                | Recovered |
| 20 73/M         | M      | NS1 Neg RT-PCR           | 2015              | 328                       | 7                                 | Cough, myalgia, diarrhoea, lethargy, poor appetite | Nil          | DF with WS        | Yes               | Recovered |
| 21 66/M         | M      | NS1 Neg RT-PCR           | 2015              | 108                       | 6                                 | Fever                    | Nil          | DF                | No                | Recovered |
| 22 36/M         | M      | NS1 Neg RT-PCR           | 2015              | 2                         | 5                                 | Lethargy                 | URTI         | DF                | No                | Recovered |
| 23 63/M         | M      | NS1 Neg RT-PCR           | 2017              | 193                       | 7                                 | Fever, myalgia, arthralgia, cough, headache, back pain | Nil          | SD                | Yes               | Recovered |
| 24 62/M         | M      | NS1 Neg RT-PCR           | 2018              | 3                         | 7                                 | Fever, nausea, vomiting, lethargy, poor urine output | Nil          | DF                | Yes               | Recovered |
| 25 40/M         | M      | NS1 Neg RT-PCR           | 2018              | 21                        | 3                                 | Fever, arthralgia, headache, myalgia | Nil          | DF                | Yes               | Recovered |
| 26 60/F         | M      | NS1 Neg RT-PCR           | 2019              | 18                        | 5                                 | Fever, sore throat, cough, myalgia | URTI         | DF                | No                | Recovered |
| 27 49/F         | M      | NS1 Neg RT-PCR           | 2019              | 199                       | 7                                 | Fever, vomiting, lower back pain | Nil          | DF with WS        | Yes               | Recovered |
| 28 50/F         | M      | NS1 Neg RT-PCR           | 2019              | 72                        | 2                                 | Fever, myalgia, poor appetite | Nil          | DF                | Yes               | Recovered |
| 29 53/F         | M      | NS1 Neg RT-PCR           | 2019              | 1                         | 10                                | Fever, poor appetite       | Nil          | DF with WS        | No                | Recovered |
| 30 39/M         | F      | NS1 Neg RT-PCR           | 2019              | 0                         | 10                                | Asymptomatic, leucopenia   | Nil          | DF                | No                | Recovered |
| 31 63/M         | M      | NS1 Neg RT-PCR           | 2019              | 9 days                    | 5                                 | Fever, thrombocytopenia, transaminitis | Nil          | DF                | No                | Recovered |

CAP: community-acquired pneumonia, CMV: cytomegalovirus, DF: dengue fever, DF with WS: dengue fever with warning signs, F: female, GE: gastroenteritis, HAP: hospital-acquired pneumonia, IgM: immunoglobulin M, M: male, ND: not done, Neg: negative, NS1: non-structural 1, Pos: positive, RT-PCR: reverse transcriptase-polymerase chain reaction, SD: severe dengue, URTI: upper respiratory tract infection, UTI: urinary tract infection, WHO: World Health Organization.
Table 3. Clinical characteristics and laboratory parameters (N=31).

| Characteristic                                      | n (%)     |
|----------------------------------------------------|-----------|
| **Clinical manifestation**                         |           |
| Fever                                              | 27 (87.1) |
| Myalgia                                            | 13 (41.9) |
| Gastrointestinal symptoms                          | 12 (38.7) |
| Headache                                           | 8 (25.8)  |
| Mucosal bleeding                                   | 3 (9.7)   |
| Arthralgia                                         | 3 (9.7)   |
| Rash                                               | 2 (6.5)   |
| Pleural effusion                                   | 4 (12.9)  |
| Ascites                                            | 1 (3.2)   |
| **WHO 2009 dengue classification**                 |           |
| Dengue infection without warning sign              | 19 (61.3) |
| Dengue infection with warning sign                 | 9 (29.0)  |
| Severe dengue                                      | 3 (9.7)   |
| **Dengue confirmatory test**                       |           |
| Non-structural 1 antigen                           | 13 (41.9) |
| Immunoglobulin M                                   | 12 (38.7) |
| Reverse transcriptase-polymerase chain reaction     | 19 (61.3) |
| **Complete blood count**                           |           |
| Platelet count at diagnosis (×10^9/L) [Ref: 140–440] | 126 (72–173) |
| Nadir platelet count (×10^9/L)                     | 31 (17–90) |
| White cell count at diagnosis (×10^9/L) [Ref: 4.0–10.0] | 5.2 (4.0–7.1) |
| Nadir white cell count (×10^9/L)                   | 2.8 (1.8–4.0) |
| Lymphocyte count at diagnosis (×10^9/L) [Ref: 1.0–3.0] | 0.8 (0.4–0.9) |
| Nadir lymphocyte count (×10^9/L)                   | 0.5 (0.3–0.6) |
| Haematocrit at diagnosis (%) [Ref: 36–46]          | 41 (34–44) |
| Peak haematocrit (%)                               | 41 (34–44) |
| **Blood chemistry**                                |           |
| ALT at diagnosis (U/L) [Ref: 6–66]                 | 32 (21–55) |
| ALT peak (U/L)                                     | 76 (24–118) |
| AST at diagnosis (U/L) [Ref: 12–42]                | 39 (29–101) |
| AST peak (U/L)                                     | 108 (42–172) |
| Cr at time of dengue diagnosis (μmol/L) [Ref: 37–75] | 140 (102–212) |
| Cr at time of dengue resolution (μmol/L)            | 112 (82–152) |

Data presented as median (interquartile range). Reference range is provided in square brackets. LT: alanine aminotransferase, AST: aspartate aminotransferase, Cr: creatinine, WHO: World Health Organization.

Most of the dengue infections were community acquired; the median time to diagnosis of dengue was 99 (IQR 18–169) months from transplant. Interestingly, two patients (Patients 30 and 31) had donor-derived dengue and developed the infection on day 10 and day 9 posttransplant, respectively [Table 2]. Both patients had received the kidneys from the same donor. Patient 31 had undergone an uncomplicated transplant surgery and was recovering well until he developed fever on the fifth postoperative day. He subsequently developed thrombocytopenia and was tested positive for dengue serotype 2 (DEN-2). Patient 30 was asymptomatic, but his laboratory tests revealed thrombocytopenia and leucopenia. Given that he received the kidney from the same donor, he was screened and tested positive for DEN-2 as well, raising the possibility that the dengue infections were donor derived. Investigations later revealed that both recipients had received the pair of kidneys from a donor who was aviraemic but had detectable dengue virus in the urine.

Laboratory findings are presented in Table 3. Seventeen (54.8%) patients had graft dysfunction, of whom ten (58.8%) had >20% but ≤50% rise in serum creatine from baseline and seven (41.2%) had >50% rise in serum creatine from baseline; 16/17 (94.1%) patients had full recovery of graft function. Only one (3.2%) required dialysis; this same patient later demised from hospital-acquired pneumonia. Dengue mortality rate was 3.2%.

**DISCUSSION**

This study identified 31 renal transplant patients who were diagnosed with dengue infection from January 2005 to October 2019. To our knowledge, this is one of the larger case series reported in Southeast Asia and the largest from Singapore, a country where dengue infection is endemic. Figure 1 shows the trend of dengue cases in Singapore and among renal transplant recipients in our institution from 2005 to 2019. In 2019, we saw the highest number of dengue infection in renal transplant recipients living in or travelling to the community, take precautionary measures to prevent mosquito bites and adopt practices to prevent mosquito breeding in their residences.
Dengue in renal transplant is largely a community-acquired infection, and our study found that its clinical course parallels that of the immunocompetent host,[5,10] with fever, myalgia, gastrointestinal symptoms and headache being the most common symptoms. Graft dysfunction is common (~54.8% of cases), but this is transient, with recovery of graft function seen in most of our patients (94.1%). Only one patient in our series required dialysis. This is concordant with other studies on renal transplant patients with dengue. Similar rates of graft dysfunction ranging between 55% and 77% were reported,[5,11,12] with majority of patients having full recovery of kidney function within 2 weeks after acute dengue. This, however, appears higher compared to the general population, where the incidence of acute kidney injury typically ranges from 1.2% to 29.6%.[13‑17] Nevertheless, we acknowledge that there are slight differences in the definitions used for graft dysfunction among various studies. Although graft dysfunction may be transient, it is still important that close monitoring and titration of fluid balances in the renal transplant patient with acute dengue infection is practised to ensure favourable outcomes and full recovery of kidney function. In addition, graft dysfunction can be considered a criterion for patient triage and admission.

The mortality rate of acute dengue infection in our renal transplant population is comparable to published data in the same population group; the mortality rates reported range from 0% to 7%.[12,18‑20] We reported one death (3.2%), which was attributed to hospital-acquired pneumonia and not directly related to dengue infection. However, it is important to note that the overall mortality from dengue in the renal transplant population is still higher than in the general population, where the mortality rates among hospitalised patients range from 0.17% to 0.77%.[21]

Cytomegalovirus (CMV) coinfection has been described in other studies, with a prevalence of 5%–66%.[12,22] A recent study by Fernandes et al.[11] showed that the subgroup of patients with dengue infection and CMV coinfection had worse thrombocytopenia, higher rate of acute graft dysfunction and longer hospitalisation time; however, there was no difference in graft loss and mortality rate. In our series, there was only one patient (3.1%) with CMV coinfection [Table 2]. This patient had CMV viraemia with no end-organ disease and was treated successfully with intravenous ganciclovir. She was on prednisolone, cyclosporine and azathioprine, with no recent change in her immunosuppressant doses before admission. Although our patient had graft dysfunction, her renal function recovered back to baseline upon discharge.

The management of immunosuppression in the setting of acute dengue infection remains an art, as there are currently no established guidelines on its use. In our study, we found that majority of physicians chose to suspend or reduce the dose of antimeabolite agents due to leucopenia, thrombocytopenia or deranged liver function test during the course of dengue. Of the 16 patients who had their antimeabolite immunosuppressants stopped or reduced, one patient subsequently developed biopsy-proven rejection 5 months after the dengue episode. She had acquired acute dengue infection within 1 month of transplantation, and her MYF dose was reduced in view of persistent viraemia. This highlights the challenges of titrating immunosuppression in renal transplant recipients with dengue infection, especially within the first 6 months of transplantation; dose reduction of immunosuppression for viral control may potentially place the patient at a higher risk of acute rejection. A large case series by Nasim et al.[12] showed that antimeabolite immunosuppressants had no effect on the severity and duration of thrombocytopenia or leucopenia. Thus, it may be safe and prudent for physicians to restart patients on...
their regular immunosuppressants soon after recovery from dengue to reduce the risk of graft rejection.

At our centre, most renal physicians chose to admit renal transplant patients infected with dengue: 30 (96.8%) patients were admitted. The median length of stay was 8 (IQR 6–13) days. This is in contrast to the practice in non-transplant patients, where dengue is increasingly managed in the community. As illustrated by Ang et al.,[21] the proportion of dengue cases hospitalised during three epidemic periods declined from 93.2% in 2004–2005 to 58.1% in 2007 and subsequently to 28.9% in 2013–2014, with no concomitant increase in adverse outcomes based on the case fatality rate. This practice of managing dengue in the community was in response to the Singapore Ministry of Health’s (MOH) periodic guidelines on the management of dengue during epidemics and refinement of the criteria for hospital referral and admission. However, this practice was not adopted in our renal transplant unit, where 96.8% of the patients were admitted and the majority (61.3%) did not have warning signs or severe dengue. This could be attributed to the more cautious approach when managing dengue in transplant recipients. Based on WHO’s recommendations[23] and our findings, renal transplant recipients with acute dengue may be considered for outpatient management with close follow-up. They include patients who (a) have no warning signs, (b) are able to maintain adequate oral hydration with satisfactory urine output, (c) have no signs of plasma leakage, and (d) show absence of graft dysfunction. Close follow-up to monitor blood counts and renal function is recommended. They should also be advised to have sufficient bed rest and hydration and to monitor for warning signs as defined by WHO. However, it would be prudent to admit patients with renal impairment or dengue with warning signs to maintain hydration and monitor for signs of plasma leakage.

Donor-derived infections (DDIs) with dengue are uncommon, with only a few cases reported in the literature. Although dengue is a vector-borne viral infection, acquisition of dengue through needle stick injury, as well as receipt of blood products, haematopoietic stem cell transplant and solid organ transplants has been described.[24-26] Interestingly, we found two cases of proven dengue DDIs in our series; both recipients had received their organs from the same donor. In Singapore, a dengue-endemic country, all solid organ donors and recipients are routinely screened for dengue in the blood by RT-PCR at the time of transplant. This practice has been instituted since 2016 (as per communication with the National Organ Transplant Unit [NOTU]). In this case, both donor and recipients had tested negative for dengue at the time of organ procurement. When both recipients later tested positive for dengue (based on clinical symptoms and laboratory findings), follow-up with NOTU revealed that the donor had developed acute dengue infection 2–3 weeks before organ harvest with serological conversion. Although the donor was aviraemic at the time of organ donation, dengue PCR was detected in her leftover urine sample, suggesting that she had prolonged shedding of DENV in the kidneys, resulting in DDIs.[27] Currently, there are no international recommendations for universal screening of urine dengue PCR in organ donors living in endemic regions. However, because of this incident case, the NOTU has since augmented the donor workup and revised its policy as of 8 April 2021 to routinely screen organ donors for dengue by testing both blood and urine for dengue RT-PCR. To date, there is no consensus on whether organs from dengue-infected donors can be used. Although donor-derived dengue was recognised early in patients 30 and 31 with favourable outcomes (no bleeding complications, no impact on graft dysfunction), complications arising from donor-derived dengue are not uncommon. Clinical symptoms for early dengue may be non-specific and diagnosis may be delayed if dengue was not suspected. In addition, severe cases of donor-derived dengue infections have also been reported; recipients may suffer severe bleeding complications (e.g., persistent haemorrhage from the operative site, haemorrhagic shock), develop major organ complications (including allograft dysfunction and loss) and potentially demise from the infection.[28,29]

In this study, a spectrum of dengue cases in the renal transplant population hospitalised with dengue has been described. This would inform the renal transplant community of the clinical manifestations of dengue in this unique population to aid clinical assessment, triaging and management. We acknowledge the limitations of this study due to its retrospective nature and potential recall bias. We also acknowledge that patients who had only mild symptoms or were asymptomatic may not have sought medical attention at our hospital and would not be captured in our database. Furthermore, information on dengue serotypes was not available for all patients, and therefore, its impact on clinical outcomes cannot be described.

In conclusion, the current study’s data on dengue infection in renal transplant population support published international data and further add confidence to the management of these patients in a dengue-endemic country. In addition, we provide recommendations on donor screening and considerations for patient triage to safely manage more patients in an outpatient setting. Management of immunosuppressants is important in this group of patients, and further studies are required to provide better guidance to renal transplant physicians.

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Conflicts of interest
There are no conflicts of interest.

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