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Case Report

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Dengue Virus Transmission via Deceased Renal Allograft: A Case Report Highlighting the Need for Donor Screening in Endemic Areas

Muhammad Abdul Mabood Khalil[a, b], Nihal Mohammed Sadagah[a], Alfatih Abdalla Altom[a], Ahmed Abdelahad Basha[a], Hinda Hassan Khideer Mahmood[a], Hisham Ismael Mohamed Sakran[a], Ibrahim Mohammed Nasser Assiri[a], Ghaleb Anas Aboalsamh[a], Salem H. Al-Qurashi[a]

Abstract

Dengue virus infection (DVI) has multiple routes of transmission. Modes of transmission include mosquito bites, perinatal transmission, blood transfusions, organ transplantation, needle stick injuries, or laboratory accidents. DVI in kidney transplant recipients is common in an endemic area. In an endemic area, it is usually caused by a mosquito bite. Solid organ transplantation, including the kidney, has been implicated in the transmission of DVI in the immediate post-transplant period. We describe a case of end-stage renal disease in which the patient got DVI immediately after getting a kidney from a deceased kidney donor. Our patient presented with fatigue and pain around the graft, anemia, thrombocytopenia, coagulopathy, hepatitis, and was found to have a hematoma around the graft. The recipient of the second kidney from the same donor also presented with fever and was found to have dengue. We describe our experience with managing our case, along with a detailed literature review of similar cases transmitted through renal allograft.

Keywords: Dengue virus infection; Transmission by renal allograft; Kidney transplant

Introduction

Dengue is an RNA virus transmitted primarily by the mosquito *Aedes aegypti* [1]. In endemic regions, dengue infection in kidney transplant recipients has mainly been attributed to bites from infected *Aedes aegypti* mosquitoes [2]. The disease may range from mild to severe, causing morbidity [3] and mortality [4]. Although most dengue virus infections (DVI) are caused by direct bites from the mosquito *Aedes aegypti*, they can be rarely transmitted through solid organ transplantation of infected organs [5]. We share our experience with DVI transmitted by infected kidneys from a deceased donor and take the opportunity to do a literature review of the clinical presentation and outcome of DVI transmitted by infected renal allografts.

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[a]Center of Renal Diseases and Transplantation, King Fahad Armed Forces Hospital, Al Andalus, Jeddah 23311, Saudi Arabia
[b]Corresponding Author: Muhammad Abdul Mabood Khalil, Center of Renal Diseases and Transplantation, King Fahad Armed Forces Hospital, Al Andalus, Jeddah 23311, Saudi Arabia. Email: doctorkhalil1975@hotmail.com

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Case Report

Investigations

A 27-year-old female (recipient 1), who is known to have type 1 diabetes, hypertension, and end-stage renal disease on hemodialysis, underwent deceased kidney transplantation on January 28, 2023. The transplantation was ABO compatible, and both donors and recipients were blood group B positive. Human leukocyte antigen (HLA) typing showed three antigen matches. There were two donor-specific antibodies (DSAs) against donor HLA CW*(12:03) with a mean fluorescence intensity (MFI) of 798, and against HLA DRB5*01:01 (DR51) with an MFI of 709. Flow cross-match for T-cell immunoglobulin (Ig)G was negative, with a mean channel shift of -51. Flow cross-match for B-cell IgG was negative, with a mean channel shift of -48. The right kidney with a double ureter from a deceased donor was implanted in King Fahad Armed Hospital on January 28, 2023, in the right iliac fossa. The recipient was treated with antithymocyte globulin (ATG), and a total dose of 4 mg/kg of ATG was administered. The recipient was started on prednisolone (Pred) and mycophenolate mofetil (MMF) as per protocol. Tacrolimus (TAC) was started on day 6. There were no medical or surgical complications. There was no delayed graft function. The patient was discharged on February 7, 2023, with a creatinine of 150 µmol/L. She presented on February 8, 2023, with pain over the graft and not feeling well. There was no fever, dysuria, or pyuria. The patient did not report any vomiting or loose motions. Clinically, she has pallor with tenderness around the graft area. Otherwise, she was afebrile with a respiratory rate of 16 breaths per minute,

blood pressure of 161/100 mm Hg, and oxygen saturation of 100% with a normal chest and cardiovascular examination.

Diagnosis

Lab workup showed a significant drop in hemoglobin from 14 g/dL to 6 g/dL. Her white blood cell (WBC) count increased from 5×10^9/L to 16×10^9/L, and then to 30×10^9/L. She had a significant drop in her platelet count to 56×10^9/L. She had mild derangement of liver enzymes, with alanine aminotransferase (ALT) at 76 U/L, aspartate aminotransferase (AST) at 148 U/L, and alkaline phosphatase at 104 U/L. Her bilirubin was 7 µmol/L. She also had derangement of coagulation with a prothrombin time (PT) of 45 s, activated partial thromboplastin time (APTT) of 51.3 s, and an international normalized ratio (INR) of 3.79. Fibrinogen levels were measured three times and were normal. Blood cultures from the peripheral vein and right internal jugular catheter were negative. Urine culture was also negative. Von Willebrand antigen was high (286%). Von Willebrand ristocetin cofactor was normal (150%). Coagulation factor XIII was normal (107%).

Ultrasound (US) of the graft with Doppler showed normal perfusion with a collection around the graft. Patient underwent a non-enhanced computed tomography (CT) scan without contrast of the abdomen and pelvis. The transplanted kidney was seen in the right iliac fossa, measuring 10 cm. A significant, extensive, and heterogeneous soft tissue density structure was observed surrounding the transplanted kidney, occupying the right iliac fossa. It extended from the superior to the inferior liver edge and inferiorly to the right side of the urinary bladder, with further extension around the medial aspect of the transplanted kidney, measuring approximately 9 × 11 × 15 cm in diameter, with a Hounsfield unit of 38. It demonstrated heterogeneous density along with fluid density and fluid levels. These findings suggested the presence of a hematoma around the graft.

The patient was re-explored on the same day of operation in the operating theatre, and no bleeding point was identified. The surgeon drained the hematoma and assumed that it was due to medical causes. Given thrombocytopenia, deranged liver enzymes, and coagulopathy, testing was done for dengue virus. The blood sample was analyzed using reverse transcription polymerase chain reaction (RT-PCR), which detected dengue virus. Furthermore, the patient tested positive for anti-dengue IgM antibodies, while IgG antibodies were reported negative. Although no pre-transplant serum or plasma samples were available to assess dengue immunity, the post-transplant positive non-structural protein 1 (NS1) antigen, IgM, and PCR, along with negative IgG, are consistent with a primary acute dengue infection.

The second kidney was implanted in the recipient (recipient 2) at another hospital in the city. Upon the diagnosis of DVI in our case, the transplant team caring for the second recipient was also informed. Recipient 2 developed fever and body aches after 9 days of the transplant. The patient had mild derangement of liver enzymes with thrombocytopenia. Given the recipient 1's history of DVI, prompt screening was conducted to rule out the infection. The patient was found to have dengue IgM antibodies and was NS1 antigen positive. However, IgG antibodies were reported negative. These results are consistent with a primary acute dengue infection. Although PCR and convalescent IgM testing were not performed, the serological profile supports recent infection rather than past exposure.

Although the detailed history from the other hospital was unavailable, the patient was treated with intravenous hydration and paracetamol and made a complete recovery. Since DVI is endemic in western Saudi Arabia, we assumed both recipients got DVI from the donor through transplanted kidneys.

We reviewed donor history in detail. The donor was a 23-year-old gentleman who was found semiconscious in the street and was brought to the hospital by ambulance on January 23, 2023. He has no past comorbidities. The patient was clinically unconscious with BP 117/68 mm Hg, pulse 102/min, and had a temperature of 37 °C. He had a temperature of 38 °C on January 26, 2023. His initial CT scan showed cerebral edema, and there was no evidence of infarct or hemorrhage. Magnetic resonance imaging (MRI) of the brain found cavernous sinus thrombosis. The CT scan of the chest, abdomen, and pelvis revealed a mild right pleural effusion with multiple alveolar infiltrates in both lungs, which became confluent posteriorly, forming consolidation with air bronchograms. His blood and urine cultures were negative. He has mild coagulopathy with thrombocytopenia along with deranged liver enzymes. The patient was admitted to the intensive care unit (ICU). Intubation was done, and he was ventilated. He was resuscitated with intravenous saline and was started on meropenem 500 mg every 8 h, along with vancomycin 1 g every 8 h. Despite respiratory support, antibiotics, and intravenous fluids, the patient remained comatose. Unfortunately, the patient did not show any neurological recovery and was diagnosed with brain death, and the family agreed to organ donation. We believe that the constellation of findings, including thrombocytopenia, derangement of liver enzymes, cavernous sinus thrombosis, and mild coagulopathy, were likely due to DVI.

Dengue is endemic in Saudi Arabia. Unfortunately, screening is not universally done in Saudi Arabia in deceased donors. Epidemiologically, the infected kidneys from the deceased donor implanted in both recipients were the likely source of transmission. Both recipients had no symptoms at baseline. They developed dengue between 9 and 10 days, which is consistent with the incubation period of 4 - 10 days of DVI. The recipients were in two different hospitals, and there was no epidemic or cluster at the time of DVI in either recipient. Most importantly, both recipients shared a common source: they had received kidneys from the same deceased donor.

Treatment

After evacuation of the hematoma, the patient received three units of packed red blood cells, four units of fresh-frozen plasmas, and two units of platelet concentrates. Her MMF was stopped, and she was treated with intravenous meropenem, given leukocytosis initially on an empirical basis. Upon diagnosis of DVI and negative culture, meropenem was held, and

the patient was resuscitated with intravenous saline and blood products. Subsequently, she received four pints of packed red blood cells, six platelet transfusions, and five doses of intravenous immunoglobulin (IVIG) at 0.4 g/kg during her stay. One week after admission, her WBC count was 5.22×10^9/L, hemoglobin was 9.7 g/dL, and platelets count was 55×10^9/L. Her liver enzymes normalized, with ALT at 18 U/L, AST at 33 U/L, and alkaline phosphatase at 71 U/L. Her clotting profile also normalized. However, her creatinine remained elevated at 175 µmol/L. The patient remained stable over the next 13 days.

Follow-up and outcomes

The patient's platelet count had normalized by February 20, 2023, to 185×10^9/L, with normalization of liver function test. She was discharged on February 28, 2023, with a creatinine level of 144 µmol/L. For the last 2 years since discharge, the patient has been under follow-up in the transplant clinic with stable graft function.

Discussion

The first dengue fever outbreak in Saudi Arabia was reported in 1994 in Jeddah, where 289 confirmed cases were reported. Since the first outbreak, there were numerous outbreaks in 2004, 2005, and 2006 [6]. Following these outbreaks, dengue is endemic in the cities of Jeddah and Makkah [6]. By the year 2009, the Ministry of Health in the Saudi Arabia had reported a total of 3,350 cases of dengue fever and a reported case fatality rate of 4.6 per thousand [7].

DVI has many manifestations, including thrombocytopenia, hepatitis, and coagulopathy [8]. The clinical findings, including a hematoma around the graft, thrombocytopenia, derangement of liver enzymes, and coagulopathy, led to suspicion of possible DVI, which was confirmed by RT-PCR in our case. We believe that the transplanted kidney was the source of infection, as the second recipient of the deceased donor's kidney also developed a fever and was found to have IgM antibodies against the dengue virus. Since the donor resided in an endemic area, transmission to both recipients via the renal allograft is a plausible explanation. The theoretical possibility of a primary infection of both recipients from the community simultaneously is less likely, as there was no epidemic. The possibility of thrombocytopenia, deranged liver enzymes, and coagulopathy [8] is an established manifestation of DVI. Thrombosis in various venous beds, including cerebral venous thrombosis, has been reported in the literature with DVI [9-11]. Fever, derangement of liver enzymes, mild coagulopathy, and cavernous sinus thrombosis in the deceased donor were possibly attributable to dengue infection. Dengue is endemic in Saudi Arabia. Unfortunately, screening is not universally done in Saudi Arabia in deceased donors. Both recipients from the same donor developed DVI at two separate centers. There was no local outbreak, making vector-borne transmission less likely.

The clinical presentation of DVI in kidney transplants differs from that of the general population. Fever, myalgia, arthralgia, and headache were significantly lower than in the normal population, while pleural effusions and ascites were observed more frequently [12]. Similarly, severe DVI is more common in transplant patients [12]. Like other viral illnesses, antimetabolites, including MMF and azathioprine, are typically withheld or reduced, especially in cases of leukopenia [13]. As our patient has severe DVI, MMF was withheld while TAC and Pred were continued. Care should be taken to restart the antimetabolites as soon as possible during recovery to minimize the risk of rejection.

Dengue transmission by solid organ transplantation (kidney, heart, and liver) has been reported [14]. Dengue has been implicated in glomerular injury [15]. Viral antigens have been detected in kidney tubular epithelial cells of infected individuals [16]; therefore, kidneys from deceased or live donors can potentially transmit infection to the recipient. Our literature search identified two cases from Brazil [5], two cases from France [17], two cases from Singapore [18, 19], one case from Thailand [20], and our present case. Summaries of all these case reports are shown in Table 1 [5, 17-20].

Approximately 78% (7/9) of transmissions occurred in deceased kidney donation as compared to 22% (2/9) in live kidney donation. This reflects that, unlike deceased kidney donation, live kidney donors are extensively evaluated in a well-planned manner, and sick donors are usually excluded or put on the waiting list until the acute issue is resolved. However, the history of DVI in a live kidney donor can still be a source of infection in a potential recipient [19]. Viral antigens are present in the tubular epithelium [16], and theoretically, the transmission of viral particles to the recipient and reactivation in the presence of intense immunosuppression may explain this phenomenon. The clinical course has been mild in 44.4% (4/9) of the cases, 33.3% have dengue hemorrhagic fever (3/9), and 22.2% (2/9) had dengue shock syndrome. Most of the instances of DVI transmitted by transplanted kidney presented 4 - 13 days post-transplantation [5, 18-20]. Derangement of liver enzymes was present in 88% of cases. This was followed by thrombocytopenia, which was present in 77.9% of the cases. One of the significant complications that we observed in 55.5% (5/9) of these patients was peri-graft hematoma around implanted kidneys [5, 17, 19, 20], which increased morbidity as these patients needed blood products and surgical evacuation of the collection. Though there was no mortality, the occurrence of DVI in the immediate post-transplant period led to more re-exploration [17, 18, 20] and a prolonged stay of 20 - 35 days [5, 17, 18]. Management of kidney transplant recipients includes symptomatic treatment, hydration, avoidance of nephrotoxic medications, and reduction of immunosuppression in the presence of cytopenia [21]. There are no specific guidelines for reducing immunosuppression. We withheld MMF and reintroduced it later once the patient fully recovered.

Some countries, such as France [22] and Singapore [23], have adopted policies for dengue virus screening before kidney donation. Important guidelines, such as those from Kidney Disease: Improving Global Outcomes (KDIGO) [24] and the American Society of Transplantation [25], provide clear recommendations for the evaluation of kidney donors with hepa-

Table 1. Summary of Case Reports Reporting DVI by Renal Allograft

Number	Reference	Journal	Age/gender	Type of renal transplantation	Clinical features & diagnostic test	Immunosuppression	Management	Outcome
Case 1	Rosso et al, 2018 [5]	Braz J Infect Dis	31/F	Deceased kidney transplantation	Needed readmission. Presented on day 8 with fever, vomiting, diarrhea, jaundice. Thrombocytopenia, lymphopenia, hepatitis. Pain over the graft with perirenal hematoma of 1,300 mL	Pred, cyclosporine (CyA), MMF	Drainage of perirenal hematoma and transfusion of red blood cells, platelets, and fresh frozen plasma	Alive and was discharged on day 25
				Donor serum retrospectively checked and found to be NS1 antigen positive	IgG+ IgM+			
					NS1+ RT-PCR+ (DEN4)		No comment on modification of immunosuppression	
Case 2	Rosso et al, 2018 [5]	Braz J Infect Dis	48/F	Deceased kidney transplantation	Presented on day 4 with fever and elevation of transaminases	Pred, CyA, MMF	Asymptomatic and conservative management. Patient was given oral ciprofloxacin for UTI.	Alive
				Donor serum was retrospectively checked and found to have NS1 antigen	Has *E. coli* UTI			
					IgG- IgM+ NS1- PCR-			
Case 3	Lecadieu et al, 2021 [17]	Am J Trop Med Hyg	58/M	Deceased kidney transplantation	Has delayed graft function and presented on day 11 with hemodynamic instability (blood pressure 76/43 and heart rate 119, abdominal pain, peri-graft infected collection, anemia, thrombocytopenia, and deranged liver enzymes.	ATG, MP, MMF, TAC	Needed vasopressors, ventilation, and dialysis, and needed transfusion of platelet concentrate, packed red cells, and fresh frozen plasma. The course was complicated by an infected hematoma caused by *Staphylococcus epidermidis* (treated with vancomycin) and ventilator-associated pneumonia by *Klebsiella pneumoniae*, treated with meropenem	Alive and discharged on day 39 with creatinine 288 µmol/L
					Blood PCR positive for DENV-1			
Case 4	Lecadieu et al, 2021 [17]	Am J Trop Med Hyg	61/M	Deceased kidney transplantation	Presented on day 12 with thrombocytopenia (64 × 10^9/L) and deranged liver enzymes (AST 220 IU/L and ALT 181 IU/L) and a normal clinical examination.	ATG, MP, MMF, TAC	Treated symptomatically	Discharged home on day 35 with creatinine 271 µmol/L
					Both blood and urine PCR were positive for DENV-1, and dengue serology was negative (IgM index 0.5 and IgG index 0.1).			
Case 5	Sim et al, 2021 [18]	Am J Transplant	63/M	Deceased kidney transplantation	Presented on day 5 with fever, thrombocytopenia, and deranged liver enzymes. No delayed graft functions	Induction basiliximab		Recovered uneventfully and was discharged home

Table 1. Summary of Case Reports Reporting DVI by Renal Allograft - *(continued)*

Number	Reference	Journal	Age/gender	Type of renal transplantation	Clinical features & diagnostic test	Immunosuppression	Management	Outcome
				Donor negative by blood RT-PCR. However, urine RT-PCR positive	RT-PCR detected	Maintenance TAC, Pred, and MMF. No comment about modification of immunosuppression		
Case 6	Sim et al, 2021 [18]	Am J Transplant	39/M	Deceased kidney transplantation	Asymptomatic with normal platelet count and mildly high alanine transaminase	Induction with ATG and MP		Recovered uneventfully and was discharged home.
				Donor negative by RT-PCR. However, urine RT-PCR was positive				
						Maintenance with TAC, Pred, and MMF. No comment about the modification of immunosuppression		
Case 7	Tan et al, 2005 [19]	Nephrol Dial Transplant	23/M	Live kidney transplantation	Presented on day 5 with fever, gastrointestinal bleeding, thrombocytopenia, leukopenia, right effusion, hemorrhagic ascites, and a large retroperitoneal hematoma arising from the bed of the transplanted kidney	Induction MP	His MMF was stopped; packed red cell and platelet transfusions were given; granulocyte colony-stimulating factor given; hematoma drained surgically.	Full recovery and graft function remained excellent
				A donor had dengue fever 6 months back	RT-PCR detected	Pred, TAC, MMF		
Case 8	Tangnararatchakit et al, 2012 [20]	Transplant Proc	15/F	Live kidney transplantation	Presented with perinephric hematoma, pancytopenia, ascites, effusion, and shock	Induction with MP followed by Pred, cyclosporine, MMF	Patient was treated via surgical drainage, transfusions, and hemodynamic support	Patient survived with full recovery of graft function
Case 9	Present case 1		27/F	Deceased kidney transplantation	Presented on day 11 with fatigue, hematoma, anemia, thrombocytopenia, deranged liver enzymes, and coagulopathy	Induction with ATG	MMF was held; IV fluid given; packed red cells, platelets, and FFP were given; hematoma was drained.	Discharged on day 20 with creatinine of 144 µmol/L
					RT-PCR detected dengue	Maintenance with Pred, MMF, TAC		

DVI: dengue virus infection; F: female; M: male; Pred: prednisolone; MMF: mycophenolate mofetil; TAC: tacrolimus; ALT: alanine aminotransferase; AST: aspartate aminotransferase; MP: methylprednisolone; UTI: urinary tract infection; Ig: immunoglobulin; ATG: antithymocyte globulin; IV intravenous; *E. coli*: *Escherichia coli*; RT-PCR: reverse transcription polymerase chain reaction; NS1: non-structural protein 1; DENV-1: dengue virus serotype 1.

titis B virus, hepatitis C virus, and human immunodeficiency virus. However, these guidelines do not recommend screening for the dengue virus in kidney donors before donation. It is essential to screen for DVI at least in endemic areas [21]. Given the variability in current practices, international transplant societies need to establish expert consensus to ensure uniform practice and provide guidance for screening policies worldwide. There are no clear guidelines on whether kidneys from a donor infected with dengue should be used. In a center in Brazil, where dengue is endemic, solid organ transplant donors who were NSI antigen positive were excluded. Those with negative NS1 antigen and having positive antibodies were allowed to donate. Authors reported no DVI after adopting this strategy [5]. Checking PCR for the presence of viremia is another way to predict transmission. If viremia is detected, the infectious reservoir will be high, and the risk of transmission will be high [26]. There is also a need for international transplant societies to develop consensus on the utilization of kidneys obtained from deceased donors. Therefore, if the dengue virus is detected by serological test in a deceased donor, checking for active viremia using PCR may be applicable for assessing the risk of transmission. Another critical point to remember is that if a recipient has a previous infection, a subsequent infection with a different dengue virus may have a worse outcome [27]. Therefore, it is essential to inquire about the potential recipient's history of DVI. It is also necessary to explain to the recipient of a kidney from an infected donor the risk of transmission, bleeding, peri-graft hematoma, and prolonged hospital stay.

We acknowledge a few limitations. As a single case report, the findings cannot be generalized to other transplant recipients. Since there is no protocol for screening deceased kidney donors in Saudi Arabia, it becomes difficult to ascertain the donor's infection status definitively and assess the risk of transmission. Another limitation of this report is the unavailability of the detailed clinical history of the second kidney recipient, who was treated at another institution.

Our case report has a few strengths. This is the first case report from Saudi Arabia where the virus is endemic, identifying an important question to screen for the dengue virus in deceased organ donation. Secondly, an extensive review of DVI in renal allograft recipients provides essential information about the course of the disease post-implantation. It identifies gaps in recommendations from various organizations and societies to guide screening for DVI in deceased donors in endemic areas.

Learning points

This case, along with the available literature, demonstrates that dengue virus transmission through renal allografts is possible. The post-transplant clinical course can be highly variable. This can range from mild dengue viral illness to severe dengue hemorrhagic fever. Screening of deceased donors in endemic regions is essential. This will help to prevent transmission to transplant recipients. There is a clear need for transplant societies and organizations to develop standardized guidelines for dengue screening in both deceased and live donors. The potential risks of transmission and associated complications should be thoroughly discussed with recipients during the consent process. Management of immunosuppression during active dengue infection also remains an area of uncertainty. Therefore, a review of current evidence and the development of consensus guidelines on adjustments of immunosuppression are needed.

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Conflict of Interest

The authors declare that they have no competing interests.

Informed Consent

Written informed consent was obtained from the patient.

Author Contributions

MAMK, SHA, NMS, and GAA conceived the study idea. MAMK drafted the initial version, and all authors (NMS, AAA, MAMK, AAB, HHKM, HIMS, IMNA, GAA, SHA) critically reviewed it. MAMK revised and all authors (NMS, AAA, MAMK, AAB, HHKM, HIMS, IMNA, GAA, SHA) approved the final manuscript.

Data Availability

All data in our report were obtained from the patient's hospitalization. Any inquiries regarding the supporting data availability of this study should be directed to the corresponding author.

Abbreviations

DVI: dengue virus infection; MMF: mycophenolate mofetil; TAC: tacrolimus; Pred: prednisolone

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