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Heart Transplant Using Hepatitis C-Seropositive and Viremic Organs in Seronegative Recipients

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Background: Hepatitis C virus (HCV)-seropositive donor hearts are underutilized for orthotopic heart transplantation (OHT). The advancement of direct-acting antiviral agent (DAA) treatment for HCV makes utilizing HCV-seropositive and viremic donor organs in HCV-seronegative recipients a possibility.

Material/Methods: From 1997 to 2019, adult patients who underwent OHT at our institution were retrospectively reviewed. Ten HCV-seronegative patients received HCV-seropositive donor hearts, 3 of which tested nucleic acid-positive. Kaplan-Meier curves were performed for survival analyses. This study was approved by the Institutional Review Board.

Results: Recipient median age was 57.5 years old, and 2 (20%) were female. Donor median age was 42 years old, and 3 (30%) were female. One donor was cured from HCV with DAA prior to OHT. Four recipients developed hepatitis C viremia immediately after OHT. DAA treatment was completed in 3 recipients who demonstrated cure. Thirty-day and 1-year survival rates were both 80%.

Conclusions: We describe 10 HCV-seronegative patients who received HCV-seropositive donor hearts at our institution, with excellent short-term outcomes, even in those who received nucleic acid testing positive organs. DAA can be effective in treating hepatitis C viremia before and after OHT, with excellent recipient survival. Large clinical studies are needed to further evaluate the long-term outcomes of DAA therapy in patients after heart transplantation.

MeSH Keywords: Antiviral Agents • Heart Transplantation • Hepacivirus

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Background

Orthotopic heart transplantation (OHT) is considered the definitive therapy for end-stage heart failure. Hepatitis C virus (HCV)-seropositive donor organs are underutilized and have been primarily used in HCV-seropositive recipients [1,2]. Given the worsening shortage of donor organs, the need to expand donor supply is urgent. The advancement of direct-acting antiviral agent (DAA) treatment for HCV has allowed us to consider the possibility of using HCV-seropositive and viremic donor organs for OHT in HCV-seronegative recipients. In this study, we describe 10 HCV-seronegative recipients who received HCV-seropositive or viremic donor hearts at Stanford University.

Material and Methods

Patients

From 1997 to 2019, adult patients who underwent OHT at our institution were retrospectively reviewed. Ten HCV-seronegative patients received HCV-seropositive donor hearts, 3 of which were nucleic acid testing (NAT) positive. The decision to use HCV-seropositive organ was made on a case-by-case basis at our institution. A multistep informed consent process is required for accepting an HCV-seropositive or viremic organ. DAA treatment was started as soon as possible after transplantation, and patients were closely followed by a multidisciplinary team to monitor for potential complications due to HCV transmission and DAA treatment.

Immunosuppression

All patients were treated according to our institution's standard immunosuppression protocol, although changes have been made over the past few decades. From 1981 to 2006, the regimen included cyclosporine, azathioprine, prednisone, and rabbit antithymocyte globulin (RATG). In 2006, mycophenolate mofetil (MMF) replaced azathioprine, and tacrolimus replaced cyclosporine. The current regimen includes intraoperative methylprednisolone, postoperative induction with RATG, as well as standard immunosuppression regimen using MMF, tacrolimus, and prednisone taper over the first year. Surveillance for rejection was performed using endomyocardial biopsy routinely.

Data collection and statistical analysis

Data collection was completed by retrospective chart review. All analyses were performed using SAS version 9.4 (SAS Institute, Inc. NC, USA). Continuous variables are presented as median (interquartile range), and categoric variables are presented as percentages. Comparisons were performed using the *t* test and Fisher's exact test. Kaplan-Meier curves were performed for survival analyses. This study was approved by the Institutional Review Board of Stanford University, and the need for consent was waived.

Results

Recipients

Recipients demographics are shown in Table 1 and Supplementary Table 1. Recipient age was 57.5 (55.3, 59.8) years old. Recipient preoperative comorbidities included hypertension in 6 (60%), dyslipidemia in 4 (40%), diabetes in 5 (50%), and coronary artery disease in 6 (60%). A left ventricular assist device (LVAD) was implanted in patient 8 (10%). One (patient 3, 10%) required preoperative intra-aortic balloon pump. Two (patient 3 and 4) were hospitalized (20%) prior to transplantation. There were no differences in preoperative baseline characteristics between those who received a NAT-positive organ versus those who received a NAT-negative organ or an organ with unknown NAT status. Indications for OHT were idiopathic cardiomyopathy (50%), ischemic cardiomyopathy (30%), congenital cardiomyopathy (10%), and familial cardiomyopathy (10%). Recipients' preoperative laboratory results are shown in Table 2 and Supplementary Table 2.

Donors and transplant operation

Donors demographics are shown in Table 1 and Supplementary Table 1. Donor age was 42 (33, 50.8) years old. HCV antibodies were positive in all donors, and NAT for HCV was positive (viremic) in 3 donors (donors 7, 8, and 10). HCV NAT was negative in 2 donors (donors 6 and 9) at the time of transplant. One (donor 9) had a history of hepatitis C viremia and was treated with ledipasvir/sofosbuvir 2 years prior to death. Other donors' NAT statuses were unavailable, as those transplant dates preceded mandatory NAT testing. There were no differences in preoperative characteristics between those who tested NAT-positive versus those who tested NAT-negative or with unknown NAT status.

A median sternotomy incision was used in all patients. Implantation was performed according to the operative technique originally described in 1960 [3]. Total allograft ischemia time was 219 (171.8, 232.5) minutes. Median distance organ travelled was 109.4 (93, 444.7) kilometers or 68 (57.8, 276.3) nautical miles.

Outcomes

Intensive care unit length of stay was 4 (2.5, 5.5) days, and hospital length of stay was 14.5 (9.5, 17) days. Postoperatively, no

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Table 1. Donor and recipient demographics and comorbidities.

Variable	Total Median [IQR] or N (%) n=10	NAT positive Median [IQR] or N (%) n=3	NAT negative or unknown Median [IQR] or N (%) n=7	p value
Donor				
Age (year)	42 [33, 50.8]	33 [33, 43.5]	44 [36.5, 50.5]	0.90
Male	7 (70%)	3 (100%)	4 (57.1%)	0.48
Ethnicity				
Caucasian	6 (60%)	2 (66.7%)	4 (57.1%)	
African American	1 (10%)	1 (33.3%)	0 (0%)	
Hispanic	3 (30%)	0 (0%)	3 (42.9%)	
Asian	0 (0%)	0 (0%)	0 (0%)	
Height (cm)	174.5 [168.5, 179.5]	176 [173, 179.5]	173 [163.5, 178.9]	0.44
Weight (kg)	72.5 [67.8, 94.8]	67.9 [63.4, 81.1]	73 [69.9, 98.3]	0.53
HCV NAT positive	3 (60%)	3 (100%)	0 (0%)	1
Hypertension	0 (0%)	0 (0%)	0 (0%)	1
Myocardial infarct	0 (0%)	0 (0%)	0 (0%)	1
Previous malignancy	0 (0%)	0 (0%)	0 (0%)	1
Tobacco use	1 (10%)	0 (0%)	1 (14.3%)	1
IV drug use	2 (25%)	2 (100%)	0 (0%)	1
Recipient				
Age (year)	57.5 [55.3, 59.8]	55 [44, 58.5]	58 [56.5, 59.5]	0.47
Male	8 (80%)	62(66.7%)	6 (85.7%)	0.53
Ethnicity				
Caucasian	6 (60%)	2 (66.7%)	4 (57.1%)	
African American	2 (20%)	0 (0%)	0 (0%)	
Hispanic	1 (10%)	1 (33.3%)	3 (42.9%)	
Asian	1 (10%)	0 (0%)	0 (0%)	
Height (cm)	171.45 [168.2, 176.6]	170.2 [168.9, 175.1]	172.7 [167.5, 175.4]	0.79
Weight (kg)	79.9 [70.5, 89.4]	78 [75.1, 81.7]	81.7 [66.8, 92.3]	0.86
Hypertension	6 (60%)	3 (100%)	3 (42.9%)	0.20
Hyperlipidemia	4 (40%)	2 (66.7%)	2 (28.6%)	0.50
Diabetes	5 (50%)	1 (33.3%)	4 (57.1%)	1
Coronary artery disease	6 (60%)	1 (33.3%)	5 (71.4%)	0.5
Dialysis	0 (0%)	0 (0%)	0 (0%)	1
Chronic obstructive pulmonary disease	1 (12.5%)	0 (0%)	1 (20%)	1
Cerebral vascular accident	1 (14.3%)	1 (50%)	0 (0%)	1
Implantable cardioverter-defibrillator	7 (77.8%)	3 (100%)	4 (66.7%)	

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Table 1 continued. Donor and recipient demographics and comorbidities.

Variable	Total Median [IQR] or N (%) n=10	NAT positive Median [IQR] or N (%) n=3	NAT negative or unknown Median [IQR] or N (%) n=7	p value
Waitlist time (days)	98.5 [8, 191.8]	113 [65, 183.5]	84 [3, 189.5]	0.80
Preoperative hospitalized	2 (33.3%)	0 (0%)	2 (50%)	1
Preoperative IABP placement	1 (10%)	0 (0%)	1 (20%)	1
Ventricular assist device	1 (16.7%)	1 (33.3%)	0 (0%)	1
Preoperative ventilation	1 (14.3%)	1 (33.3%)	0 (0%)	1

HCV – hepatitis C virus; IABP – intra-aortic balloon pump; IQR – interquartile range; IV – intravenous; NAT – nucleic acid testing.

Table 2. Preoperative recipient laboratory results.

Variable	Total Median [IQR] or N (%) n=10	NAT positive Median [IQR] or N (%) n=3	NAT negative or unknown Median [IQR] or N (%) n=7	p value
Creatinine (mg/dL)	1.17 [0.98, 1.4]	1.29 [0.93, 1.3]	1.04 [1, 1.4]	0.54
AST (U/L)	21 [19, 26]	20 [17, 21.5]	25 [20.3, 56.5]	0.34
ALT (U/L)	23 [17, 31]	20 [17, 21.5]	31 [25.3, 105.5]	0.36
Total bilirubin (mg/dL)	0.9 [0.55, 1.2]	0.9 [0.65, 0.9]	1.05 [0.58, 1.7]	0.35
HCV Antibody	0 (0%)	0 (0%)	0 (0%)	1
HBcAb	0 (0%)	0 (0%)	0 (0%)	1
HBsAg	0 (0%)	0 (0%)	0 (0%)	1
HBsAb	1 (33.3%)	0 (0%)	1 (100%)	1
HIV	0 (0%)	0 (0%)	0 (0%)	1
CMV IgG	4 (40%)	0 (0%)	4 (57.1%)	1

ALT – alanine transferase; AST – aspartate aminotransferase; CMV – Cytomegalovirus; HBcAb – hepatitis B core antibody; HBsAb – hepatitis B surface antibody; HBsAg – hepatitis B surface antigen; HCV – hepatitis C virus; HIV: human immunodeficiency virus; IQR – interquartile range; NAT – nucleic acid testing.

patient suffered cerebral vascular accident, myocardial infarction, respiratory failure, pneumonia, sepsis, or urinary tract infection, and no patient needed a pacemaker, implantable cardioverter defibrillator placement, postoperative transfusion, or any kind of mechanical circulatory support. Only patient 10 developed renal failure requiring dialysis.

Postoperative recipient seropositivity, liver functions, and allograft outcomes are shown in Table 3 and Supplementary Tables 3, 4, and there were no differences observed between those who received a NAT-positive organ versus those who received a NAT-negative organ or an organ with unknown NAT status. For patient 7, 8, and 10 who received NAT-positive donor organs, immediate postoperative transaminitis was observed but quickly resolved prior to discharge. There were no additional transaminitis episodes observed postoperatively. Specifically, patient 7's HCV viral load peaked at postoperative week 2, and he was treated with sofosbuvir/velpatasvir (Epclusa®) 2 weeks after OHT and cleared HCV viremia by postoperative week 4. Patient 8's HCV viral load was the highest immediately after OHT, and she was treated with ledipasvir/sofosbuvir (Harvoni®) 2 weeks after OHT and cleared viremia by postoperative week 6. Both patients had sustained viral response at 8 months or longer. Patient 10's HCV viral load peaked at over 8 million IU/mL 3 days after OHT. His treatment with glecaprevir/pibrentasvir (Mavyret®) was started on postoperative day 25, and he cleared viremia by postoperative week 8. All 3 patients' DAA therapies were approved by insurance prior to treatment, and no adverse effects were observed during the treatment. All 3 patients' viral load remained undetectable after treatment.

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Table 3. Postoperative outcomes.

Variable	Total Median [IQR] or N (%) n=10	NAT positive Median [IQR] or N (%) n=3	NAT negative or unknown Median [IQR] or N (%) n=7	p value
Hospital length of stay (days)	14.5 [9.5, 17]	21.5 [19.3, 23.8]	13 [4.5, 14.75]	0.17
ICU length of stay (days)	4 [2.5, 5.5]	8 [7, 9]	3 [2, 4]	0.19
Peak AST (U/L)	116 [89.5, 201.5]	180 [148, 213.5]	89.5 [63.5, 133.8]	0.25
Peak ALT (U/L)	50 [40, 98]	52 [40.5, 98]	47.5 [42.5, 73.8]	0.89
Peak bilirubin (mg/dL)	1.9 [1.1, 2]	1.9 [1.3, 2.8]	1.5 [1.1, 2.0]	0.62
Antibody-mediated rejection	0 (0%)	0 (0%)	0 (0%)	1
Acute cellular rejection	0 (0%)	0 (0%)	0 (0%)	1
Allograft vasculopathy	2 (20%)	0 (0%)	2 (28.6%)	1
Graft failure	0 (0%)	0 (0%)	0 (0%)	1

ALT – alanine transferase; AST – aspartate aminotransferase; ICU – Intensive Care Unit; IQR – interquartile range; NAT – nucleic acid testing.

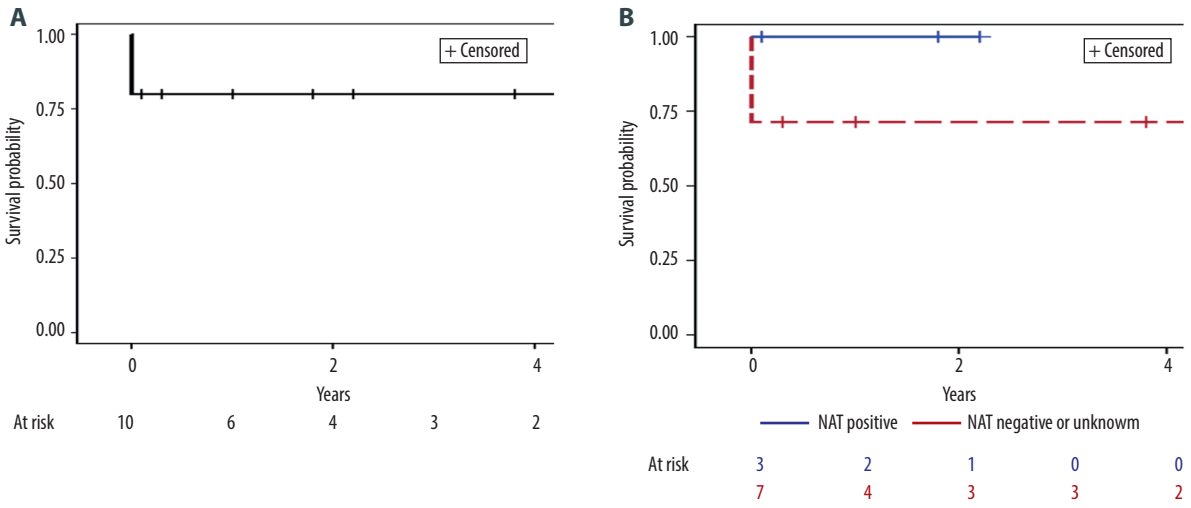

Figure 1. (**A**) Kaplan-Meier survival curve for all patients. (**B**) Kaplan-Meier survival curves for patients who received hepatitis C virus (HCV) nucleic acid testing (NAT) positive organs (blue) compared to those who received organs with negative HCV NAT or unknown NAT status (red).

For patient 6 and 9, who received NAT-negative organs, similarly immediate postoperative transaminitis was observed but quickly resolved prior to discharge and remained under normal limits postoperatively. Although patient 6 did not have viral load results collected, patient 9 continued to have an undetected viral load postoperatively.

Among patients who received organs with unknown NAT status, only patient 4 was found to have HCV viremia soon after OHT (Supplementary Table 3). Interferon treatment was declined by the patient. He continued to have multiple mild transaminitis episodes, with the highest aspartate aminotransferase and alanine transferase level of 137 and 117 U/L 5 years postoperatively. He eventually developed allograft vasculopathy without cirrhosis or hepatocellular carcinoma and died 7.5 years after OHT due to heart failure. Patient 2 developed mild to moderate acute cellular rejection within the first year and subsequently developed allograft vasculopathy. Patient 5 continued to have normal liver function test results after discharge. Patient 1 and 3 did not have data available for review.

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The follow-up period ranged from 1 day to 21.1 years, with no loss to follow-up. Patients 1 and 3 died on postoperative day 2 and 1, respectively (Supplementary Table 4). Thirty-day and 1-year overall survivals were both 80%, with a median survival of 7.5 years (Figure 1A). One-year survival using known HCV-viremic donor hearts with DAA treatment was 100% (Figure 1B).

Discussion

In this study, we describe our experience in using HCV-seropositive and NAT-positive donor hearts for OHT in HCV-seronegative recipients, with excellent short and medium-term outcomes. We also demonstrate the outcomes of using an organ from a previously HCV-infected donor who was treated with DAAs.

The current organ shortage has been a challenge in the treatment of end-stage heart failure. According to the United Network for Organ Sharing (UNOS), 3408 hearts were transplanted in 2018 in the United States, but many more candidates remained on the waiting list. Significant efforts have been made to expand the organ supply [4,5]. Notably, many potential donors who died of drug overdose were HCV-infected [6,7], but only a small fraction of those organs was recovered [6]. Acceptance of HCV-seropositive donors may result in 300–500 additional organs for transplantation annually in the United States [6].

In August 2015, UNOS mandated donor HCV NAT results in addition to serologic data. The availability of HCV NAT data in recent years is consistent with this policy change. We suspect that most of the patients who had positive HCV serologic results were NAT-negative prior to 2015. HCV-seropositive donors without viremia have not been documented to transmit HCV, whereas transmission from HCV-viremic donors is likely [6]. HCV NAT testing can significantly decrease the risk of undetected infection, providing a more accurate assessment of transmission risk rather than using serologic testing alone.

The decision to use HCV-seropositive organ was made on a case-by-case basis at our institution. Prior to 2015, patients who received organs with HCV seropositivity with unknown NAT status demonstrated pressing clinical need for transplant. In fact, 1 patient received an organ on the day of listing, and the other received a suitable organ the next day after listing. Donors' HCV serologic status and the possible risk of HCV transmission were disclosed to all recipients and their family members prior to OHT. Currently, a multistep informed consent process is required for accepting an HCV-infected (seropositive or viremic) organ at our institution. The consent provides patient education and clearly communicates unknown risks of HCV transmission, complications associated with HCV, and adverse effects of treatment. Insurance coverage for DAA therapy is investigated to ensure timely DAA access postoperatively if indicated. Counseling regarding the possible risk of HCV transmission is provided early in the perioperative period. Patients are be closely followed by a multidisciplinary team to monitor for potential complications due to HCV transmission and DAA treatment.

Two patients in this cohort warrant special attention. Patient 4, who was found to hepatitis C-positive after OHT did not receive interferon therapy, and DAAs were not available at that time. It remained unclear whether the donor organ was viremic at the time of transplantation or the recipient was newly infected with HCV virus. Patient 9's donor organ was HCV NAT-negative. However, the donor had HCV viremia, which was successfully treated 2 years prior to organ donation. The recipient, patient 9, never received DAA treatment after OHT, and his HCV testing remained negative 3 months after OHT. This shows that DAA therapies are not only effective in treating primary HCV infection, but can also prevent viral transmission, even after the previously infected organ was transplanted into an HCV-seronegative recipient without any additional DAA treatment. In this case, it may be reasonable to hypothesize that the risk of viral transmission in using organs already treated for HCV infection is similar to those with seropositive but NAT-negative results. Further studies are warranted to investigate the effect of DAA treatment on donors prior to OHT.

Current DAAs, such as Mavyret® and Epclusa®, have clinical cure rates greater than 90% for all genotypes in the non-transplant population. This means that treatment can potentially be started as soon as possible, even before the genotype of HCV is known. These drugs also have fewer adverse effects than older regimens such as interferon-containing medications, making patient adherence easier. In our cohort, 2 patients were started on DAA therapy 2 weeks after OHT while in the hospital, and the other patient received DAA treatment 3 weeks after OHT after discharge. The timing of treatment initiation depends on the recipients' insurance plan and approval, but in general, it has not been a difficult process in our experience.

Current guidelines by the American Association for the Study of Liver Disease and the Infectious Disease Society of America recommend treatment for all patients with HCV, including those with kidney and liver transplants, for whom data is most readily available [8]. Although data are limited in the heart transplant population, studies have shown excellent sustained viral response with DAAs [9,10]. While these initial findings provide much hope, additional follow-up will be needed to determine long-term outcomes, such as the impact on rejection rates and cardiac allograft vasculopathy.

A treatment course with DAAs can be expensive, ranging roughly from $30 000 to $100 000, depending on the regimen, but

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remaining on the heart transplant waiting list for an indefinite period of time or receiving a durable mechanical cardiac support, such as an LVAD, can also be very costly. According to the study published by Baras Shreibati et al., the mean cost of LVAD implantation alone was $175 420, and the mean cost of pump replacement was $90 147 [11]. This would exceed the cost of DAA therapy if patients were to receive donor hearts that were HCV NAT-positive. An economic analysis of utilizing HCV-seropositive donors in the heart transplantation community and its benefits would also be a valued addition to the literature.

Conclusions

In conclusion, this study demonstrates excellent short-term outcomes of using hepatitis C-seropositive and viremic organs in hepatitis C-seronegative recipients for heart transplantation. Successful use of DAAs would further broaden the opportunity to expand donor organ usage by using HCV-viremic organs with or without prior treatment. Large clinical studies are needed to further evaluate the long-term outcomes of DAA therapy in patients after heart transplantation.

Acknowledgments

We would like to thank Bharathi Lingala for performing Kaplan-Meier analyses for this study.

Conflicts of interest

None.

Supplementary Data

Supplementary Table 1. Recipients and donors' demographics.

Patient	Year of surgery	Recipient age (years); gender	Recipient ethnicity	Recipient height (cm)	Recipient weight (kg)	Donor age (years); Gender	Donor Ethnicity	Donor Height (cm)	Donor Weight (kg)	HCV NAT
1	1997	62; Male	Caucasian	160	63.5	50; Female	Caucasian	154.9	73	–
2	1997	52; Female	African American	165	81.7	15; Female	Hispanic	173	72	–
3	1998	56; Male	Asian	173	70	40; Male	Hispanic	168	65	–
4	2002	58; Male	Caucasian	180.3	90.7	44; Male	Caucasian	180	102	–
5	2010	57; Male	African American	172.7	93.9	51; Male	Caucasian	188	95	–
6	2015	60; Male	Caucasian	177.8	94.8	33; Male	Hispanic	177.8	101.5	Negative
7	2017	33; Male	Hispanic	170.2	72.1	33; Male	African American	183	94.2	Positive
8	2017	55; Female	Caucasian	167.6	78	54; Male	Caucasian	170	59	Positive
9	2019	59; Male	Caucasian	170	63.3	55; Female	Caucasian	159	67.8	Negative
10	2019	62; Male	Caucasian	180	85.4	33; Male	Caucasian	176	67.9	Positive

HCV – hepatitis C virus, NAT – nucleic acid testing.

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Supplementary Table 2. Recipients preoperative laboratory results.

Patient	Creatinine (mg/dL)	AST/ALT (U/L)	Total bilirubin (mg/dL)	HCV Ab	HBcAb	HIV	CMV IgG
1	–	–	–	Negative	Negative	Negative	Negative
2	–	–	–	Negative	Negative	Negative	Positive
3	1	18/33	0.6	Negative	Negative	Negative	Positive
4	0.9	139/323	1.5	Negative	Negative	Negative	Negative
5	1.4	21/29	0.5	Negative	Negative	Negative	Positive
6	2.1	–	–	Negative	Negative	Negative	Negative
7	1.29	23/20	0.9	Negative	Negative	Negative	Negative
8	0.57	20/14	0.4	Negative	Negative	Negative	Negative
9	1.04	29/14	2.1	Negative	Negative	Negative	Positive
10	1.34	14/23	0.9	Negative	Negative	Negative	Negative

ALT – alanine transferase; AST – aspartate aminotransferase; CMV – Cytomegalovirus; HBcAb – hepatitis B core antibody; HIV – human immunodeficiency virus.

Supplementary Table 3. Postoperative seropositivity.

Patient	Genotype	Immediate postoperative HCV RNA	Week 2 HCV RNA	Week 8 HCV RNA	Week 12 HCV RNA	Month 6 HCV RNA	Month 12 HCV RNA
1	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–
3	–	–	–	–	–	–	–
4	1B	–	–	–	11,000 (IU/mL)	–	4,600,000 (IU/ml)
5	–	–	–	–	–	–	–
6	–	–	–	–	–	–	–
7	1A	604 (IU/mL)	191,078 (IU/mL)	Undetected	Undetected	Undetected	Undetected
8	1A	4774 (IU/mL)	Undetected	Undetected	Undetected	Undetected	Undetected
9*	–	–	Undetected	–	Undetected	Undetected	–
10	1A	8,028,535 (IU/mL)	<25 (IU/mL)	Undetected	Undetected	–	–

RNA – ribonucleic acid. * Patient 9 was recommended to be tested for HCV RNA at 3, 6 and 12 months postoperatively.

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Supplementary Table 4. Postoperative outcomes.

Patient	Peak perioperative AST/ALT (U/L)	Peak perioperative total bilirubin (mg/dL)	AMR	ACR	Allograft vasculopathy	Graft failure	Death	Survival	Cause of death
1	–	–	None	None	No	No	Yes	2 days	Unknown
2	–	–	None	Yes	Yes	No	Yes	18 years	Metastatic colon cancer
3	–	–	None	None	No	No	Yes	1 day	Tamponade, heart failure
4	75/145	1.1	None	None	Yes	No	Yes	7.5 years	Heart failure
5	104/45	2.1	None	None	No	No	No		
6	223/50	1.9	None	None	No	No	No		
7	247/52	3.6	None	None	No	No	No		
8	116/29	0.6	None	None	No	No	No		
9	29/35	1	None	None	No	No	No		
10	180/144	1.9	None	None	No	No	No		

ACR – acute cellular rejection; ALT – alanine transferase; AMR – antibody-mediated rejection; AST – aspartate aminotransferase.

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