The Travails of Setting Up a Living Donor Liver Transplant Program: Experience From Pakistan and Lessons Learned

Faisal Saud Dar,1 Abu Bakar Hafeez Bhatti,1 Abdul-Wahab Dogar,1 Haseeb Zia,1 Sadaf Amin,1 Atif Rana,2 Rashid Nazer,2 Nasir Ayub Khan,3 Etizaz-ud-din Khan,1 Muhammad Zameer Rajput,3,4 Muhammad Salih,5 and Najmul Hassan Shah5

Departments of 1Hepato-Pancreato-Biliary and Liver Transplant Surgery, 2Radiology, 3Anesthesia, 4Intensive Care, and 5Transplant Hepatology, Shifa International Hospital, Islamabad, Pakistan

Living donor liver transplantation (LDLT) is the only treatment option for patients with end-stage liver disease (ESLD) where cadaveric donors are not available. In developing countries, the inception of LDLT programs remains a challenge. The first successful liver transplantation program in Pakistan started transplantation in 2012. The objective of this study was to report outcomes of 100 LDLT recipients in a developing country and to highlight the challenges encountered by a new LDLT program in a resource-limited setting. We retrospectively reviewed recipients who underwent LDLT between April 2012 and August 2014. Demographics, etiology, graft characteristics, and operative variables were assessed. Outcome was assessed on the basis of morbidity and mortality. All complications of ≥ 3 on the Clavien-Dindo grading system were included as morbidity. Estimated 1-year survival was calculated using Kaplan-Meier curves, and a Log-rank test was used to determine the significance. Outcomes between the first 50 LDLTs (group 1) and latter 50 LDLTs (group 2) were also compared. Median age was 46.5 (0.5-72) years, whereas the median MELD score was 15.5 (7-37). The male to female ratio was 4:1. ESLD secondary to hepatitis C virus was the most common indication (73% patients). There were 52 (52%) significant (≥ grade 3) complications. The most common morbidities were bile leaks in 9 (9%) and biliary strictures in 14 (14%) patients. Overall mortality in patients who underwent LDLT for ESLD was 10.6%. Estimated 1-year survival was 87%. Patients who underwent transplantation in the latter period had a significantly lower overall complication rate (36% versus 68%; \( P = 0.01 \)). Comparable outcomes can be achieved in a new LDLT program in a developing country. Outcomes improve as experience increases. Liver Transpl 21:982-990, 2015. © 2015 AASLD.

Received March 24, 2015; accepted April 7, 2015.

Living donor liver transplantation (LDLT) was initially attempted to help reduce mortality in pediatric recipients waiting for size-matched deceased livers.1,2 Although deceased donor liver transplantation was the predominant mode of organ donation, in certain countries, it was not well accepted because of social norms and religious beliefs. This translated into an ever expanding application of LDLT in certain parts of the world.3 Despite increased complexity of the LDLT procedure, successful outcomes were reported from...
Japan in the 1990s. In India, LDLT became popular from the year 2005 onward because of the extensive burden of end-stage liver disease (ESLD). With a population of more than 180 million and a 7% combined burden of hepatitis B virus (HBV) and hepatitis C virus (HCV), it was imperative to have an indigenous liver transplantation (LT) program in Pakistan. Patients generally travelled to India and China where it was much cheaper to undergo transplantation than the United States and Europe. Even this option could be availed by very few who could afford transplantation surgery and arrange for frequent follow-ups.

LDLT requires the highest level of technical expertise and stringent, but expensive, perioperative care to achieve the desired results. The inception of a LT program was viewed with skepticism in Pakistan. Cultural and religious beliefs, lack of public awareness, risks of commercialization, nonexistence of a financial support system, and a small number of centers with ventilatory support and facilities for liver surgery were cited for the failure of not having a program.

The objective of the current study was to report the outcomes of 100 LDLT recipients from Pakistan’s first LDLT program and to discuss solutions to potential obstacles in its development and sustenance in a developing country.

PATIENTS AND METHODS

The first LT program in Pakistan started transplantation in 2012 at Shifa International Hospital in Islamabad, Pakistan, and the first LT was performed in April 2012. A total of 135 LDLTs have been performed between that time and December 2014. We retrospectively reviewed recipients who underwent transplantation at our center. For the purpose of this study, 100 patients who underwent transplantation between April 2012 and August 2014 were included to ensure a minimum follow-up of 3 months.

Donor Selection and Evaluation

All potential donors were in good general health, between 18 and 50 years of age, blood group compatible, and related to the recipient. The Human Organ Tissue and Transplant Authority (HOTA) of Pakistan allows donation of liver grafts to unrelated recipients only in extreme circumstances. Up until now, we have not performed any unrelated donations at our center. A surgical plan was based on volumetric assessment and 3D reconstruction that was pasted in the operating room at the time of surgery. Table 1 demonstrates the steps in donor evaluation.

Initial evaluation included a detailed history and physical examination followed by laboratory investigations. Computed tomography (CT) with a dynamic liver protocol was performed. A CT scan was performed using a 320 multidetector CT scanner (Aquilion ONE 320 Slice CT). The complete scan included the acquisition of an unenhanced series followed by the arterial and portal venous phases. The whole examination took approximately 75 to 90 seconds. Images were reconstructed and analyzed by 2 radiologists (A.R. and R.N.) who have more than 10 years of experience. The liver volumetry for right and left lobes was performed using the middle hepatic vein (MHV) as the cut plane. Biliary anatomy was delineated on magnetic resonance cholangiopancreatography (MRCP) with the aid of a 3D reconstruction. The minimum acceptable donor residual liver volume was 30% at our center. We do not perform conventional angiography in our patients. Liver biopsy was reserved for patients with a liver attenuation index of <5. All donors were reviewed by an independent physician. Informed consent was obtained from donors with an awareness of the voluntary nature of donation and an acknowledgment of their right to refuse donation at any time. Approval of the donation was given by the ethical committee of the hospital and finally by HOTA.

Recipient Evaluation

After a clear indication for LT was established, recipients underwent a stepwise evaluation process. Table 2 demonstrates the recipient evaluation process excluding the investigations mentioned in Table 1.
Recipients were started on the same day as surgery, and pressor therapy, primarily in the form of tacrolimus and steroids, was initiated 24 hours after surgery. Central venous pressure was weaned off ventilation as early as possible, usually 12 hours after reperfusion. Saline was injected via the recipient’s portal vein to identify and secure biliary leaks. An intraoperative Doppler ultrasound of the liver was performed to assess blood flow and prevent bowel congestion during the anhepatic phase. Venovenous bypass and inflow occlusion was not performed. The portal vein was dissected, and portal structures were identified and divided as high as possible. We used a temporary portocaval shunt to prevent ascites; otherwise, a Mercedes-Benz incision was used. After mobilization of the left and right lobes, porta hepatitis was dissected, and portal structures were identified and divided as high as possible. We performed a temporary portocaval shunt to prevent bowel congestion during the anhepatic phase. Venous bypass and inflow occlusion was not performed. An intraoperative Doppler ultrasound of the liver was performed to confirm the inflow and outflow patency after reperfusion. Saline was injected via the recipient’s cystic duct to identify and secure biliary leaks.

Postoperative Management

Both donors and recipients were shifted to the intensive care unit (ICU) after the operation. Recipients were weaned off ventilation as early as possible, usually 12 to 24 hours after surgery. Central venous pressure was kept between 5 and 10 cm of water. Immunosuppression, primarily in the form of tacrolimus and steroids, was started on the same day as surgery, and levels were tested on every second day. A Doppler ultrasound was performed once daily until the fifth postoperative day. Drains were removed at the earliest and were not kept for more than 10 days.

Statistical Analysis

Data on the patient demographics, etiology of liver failure, graft characteristics, and operative variables were retrospectively collected. Categorical variables were represented as frequencies and percentages, whereas interval variables were given as medians and ranges. All grade 3 and above complications on the Clavien-Dindo grading system were included as morbidity. Because of the retrospective nature of the study, it was difficult to ensure inclusion of all grade 1 and 2 complications, and they were not assessed. Early morbidity and mortality were defined as adverse events within 90 days of the procedure. To determine the statistical significance between categorical variables, chi-square test and Fisher’s exact test were used. Recipients in the pediatric group were also separately assessed for various demographic and outcome variables. We also compared outcomes between 2 treatment groups, ie, the initial 50 and the latter 50 transplant recipients. This division was representative of the increased autonomy of our unit in terms of international collaboration. A regular multidisciplinary team meeting and transplant listing meeting was standardized. The institutional protocol for perioperative care, immunosuppression, and infection control practices were streamlined. Also training in hepatobiliary and transplant surgery was initiated at this time. Survival time was calculated by subtracting the date of death/last follow-up from the date of transplant. Estimated 1-year survival was calculated using Kaplan-Meier curves, and Log-rank tests were used to determine the significance between the 2 treatment groups. A P value of < 0.05 was considered statistically significant. Data analyses were performed on SPSS version 20 (IBM Corporation, Armonk, NY). This was a retrospective study and was performed in accordance with declaration of Helsinki. No potential identifiers were present and no intervention was performed. The study was exempted from formal review by ethics committee.

RESULTS

Recipient Characteristics

Table 3 presents the recipient’s characteristics. The median age was 46.5 (0.5–72) years, and the male to female ratio was 4:1. ESLD secondary to HCV was the most common indication in 73 (73%) patients. There were 6 (6%) patients who underwent transplantation secondary to acute liver failure. The median Model for End-Stage Liver Disease (MELD) score in the study group was 15.5 (7–37). Out of the 100 patients, 66 (66%) patients were Child-Turcotte-Pugh (CTP) grade C at the time of presentation. Common donors were sons (19 patients) and nephews (14 patients). Figure 1 demonstrates a gradual increase in the number of transplants during the study duration distributed.
over 6-month periods. There was a 3-fold increase in the number of procedures between April and September 2012 and April to August 2014, i.e., 9 versus 32 procedures.

Graft Characteristics and Operative Variables

Table 4 represents the graft characteristics and operative variables. A total of 61 (61%) patients received right lobe grafts without MHV. Left lateral segments (4 patients) and left lobes (2 patients) were used in pediatric patients, whereas the whole liver was used in 1 patient as a domino graft. More than 1 hepatic vein was reconstructed in 60 (60%) recipients, whereas more than 1 biliary anastomosis was fashioned in 22 (22%) patients. All patients had a duct-to-duct biliary anastomosis, except for 3 (3%) cases where hepaticojejunostomy was performed. Most patients (92%) had a temporary portocaval shunt which was taken down at the time of graft implantation. The lowest estimated graft weight to body weight ratio was 0.78, whereas the highest was 2 in the recipient of the whole liver. The median operative time was 555 (330-1440) minutes.

Morbidity

A total of 52 (52%) complications were observed in the postoperative period. There were 30 grade 3A, 7 grade 3B, 5 grade 4A, and 10 grade 5 complications as shown in Table 5. Of these, biliary complications were the most common and included bile leaks in 9 (9%) patients and biliary stricture in 14 (14%) patients. Bile leaks were managed with percutaneous drain placement in 5 patients, endoscopic retrograde cholangiopancreatography (ERCP) in 3 patients, and reexploration with t-tube repair in 1 patient. Patients with biliary strictures were managed with ERCP or percutaneous transhepatic cholangiography. None of the patients developed hepatic artery or venous thrombosis, whereas portal vein stenosis was observed in 1 patient. Six patients required intervention for postoperative bleeding. Of these 4 had coagulopathy; 1 had bleeding from drain site and 1 from hepatic artery. Reexploration was required in 5 patients. Seven patients developed significant pleural effusions requiring ultrasound-guided aspiration/drain placement.

Mortality

At the time of last follow-up, 87 (87%) recipients were alive. Out of 13 mortalities, 3 had an underlying acute liver failure. Excluding patients with acute liver failure, the overall mortality was 10.6% in 10/94 patients. One patient had graft failure because the graft artery was short and had fragile walls. Three
attempts were made at anastomoses which were unsuccessful. Finally, arterialization of the portal vein with a common hepatic artery was performed, but the patient died because of graft dysfunction. One patient developed hepatocellular carcinoma (HCC) recurrence with pulmonary metastasis and succumbed to tumor recurrence. Other than mortalities secondary to grade 5 complications, there were 3 deaths. Because of noncompliance with immunosuppressive medications, 1 patient died at 8 months posttransplant. One patient with acute liver failure underwent transplantation and did not survive due to brain hemorrhage, whereas 1 patient had myocardial infarction. The estimated 1-year survival was 87%.

**Comparison of Outcomes Between Treatment Groups**

A significant difference was present between the 2 groups with respect to overall morbidity. Patients who underwent transplantation in the latter period had a significantly lower overall complication rate (36% versus 68%; \( P=0.01 \)). On the basis of the grade of complications, a significant reduction was observed for grade 3A complications (20% versus 40%; \( P=0.02 \)). Although grade 3B and 4A complications also reduced over time, a significant difference was not observed as shown in Table 6. Biliary complications reduced from 36% to 12% (\( P=0.01 \); not shown). A similar trend was observed for 90-day mortality between the 2 groups, but it did not reach statistical significance as shown in Table 6. Estimated 1-year survival was significantly different between the 2 treatment groups (80% versus 94%; \( P=0.04 \)) as shown in Fig. 2.

**Pediatric Patients**

Nine patients were pediatric. The median age was 12 (0.5-17) years. The youngest recipient was a 6-month old baby. There were 6 (66.6%) complications in pediatric recipients including 3 grade 3A, 1 grade 3B, and 2 grade 5 complications. Re-exploration was performed in 1 child with iatrogenic colonic perforation and in another with multiple bowel perforations secondary to widespread mesenteric and bowel aspergillosis. At the last follow-up, 7 (77.8%) out of 9 recipients were alive and doing well. Mesenteric aspergillosis and recurrent chest infection were responsible for death in 2 patients. Table 7 represents various characteristics of our pediatric patients.
TABLE 6. Morbidity and Mortality in Initial (First 50) and Latter (Last 50) LTs

<table>
<thead>
<tr>
<th></th>
<th>Initial Experience</th>
<th>Latter Experience</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patients, n = 50</td>
<td>Percent</td>
<td>Patients, n = 50</td>
</tr>
<tr>
<td>Overall morbidity</td>
<td>34</td>
<td>68</td>
<td>18</td>
</tr>
<tr>
<td>Grade 3A</td>
<td>20</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Grade 3B</td>
<td>5</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Grade 4A</td>
<td>4</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Grade 5</td>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>90-day mortality</td>
<td>8</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>

DISCUSSION

The present study reports outcomes of 100 LDLT recipients in the Pakistani population. It also highlights several important issues that must be addressed before embarking upon this daunting task in a developing country with various financial and social restrictions. Improving outcomes in the latter part of the study are promising. Regarding limitations, the retrospective design has the potential to have missed significant data in recipients. Follow-up is relatively short to comment upon some of the complications like biliary strictures that take longer to develop.

Although HCV is a frequent indication for LT in many countries, the proportion of patients in the current study was alarmingly high compared to other studies.\(^3,6,10,11,14\) A biliary complication rate between 5.3% and 40.6% has been previously reported, and our biliary complication rate falls well within this range.\(^9,15,20\) Duct-to-duct anastomosis and high hilar dissection reduces incidence of life-threatening biliary complications.\(^15\) All of these techniques are practiced at our center. The best way to reduce biliary complication might rest in selection of donors with favorable anatomy.\(^16\) Although it appears logical, stringent eligibility criteria make it difficult to refuse donors merely on the basis of less favorable anatomy.

The frequency of hepatic artery thrombosis (HAT) is reported between 2% and 12%.\(^10,21,22\) None of the patients developed HAT or outflow problems. We believe that sound surgical techniques and the

TABLE 7. Characteristics and Outcomes in Pediatric Patients

<table>
<thead>
<tr>
<th></th>
<th>Patients, n = 9</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, males</td>
<td>6</td>
<td>66.6</td>
</tr>
<tr>
<td>Etiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criggler-Najjar syndrome</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>Wilson’s disease</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>Cryptogenic</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>Extrabiliary biliary atresia</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Primary hyperoxaluria</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Autoimmune</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Onset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute</td>
<td>3</td>
<td>33.3</td>
</tr>
<tr>
<td>Chronic</td>
<td>6</td>
<td>66.6</td>
</tr>
<tr>
<td>Type of graft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left lateral segment</td>
<td>4</td>
<td>44.5</td>
</tr>
<tr>
<td>Left lobe with MHV</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>Right lobe without MHV</td>
<td>3</td>
<td>33.3</td>
</tr>
<tr>
<td>Grade 3 complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colonic perforation</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Invasive aspergillosis</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Bile leak</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>Chyle leak</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Chest infection</td>
<td>1</td>
<td>11.1</td>
</tr>
<tr>
<td>Alive at last follow-up</td>
<td>7</td>
<td>77.8</td>
</tr>
</tbody>
</table>
The routine use of intraoperative Doppler greatly helped in reducing vascular complications.

A high CTP score has been linked to a high complication rate although a recent meta-analysis contradicts this view.23,24 Similarly, no association between high MELD scores and posttransplant mortality has been demonstrated.25-28 Almost two-thirds of patients in the current study were CTP C representing severe derangements in liver function. We achieved good results because of high graft quality. Healthy donors between 18 and 50 years of age, absence of comorbidities, and minimal hepatic steatosis ensured good graft quality. Donors and recipients were both instructed to improve nutritional status, physical activity, and cessation of smoking. In comparison with overall outcomes, our pediatric complication rate was high. Underlying acute failure in 3 out of 9 patients, absence of a pediatric ICU and intensivist, and the learning curve might contribute to overall outcomes.

According to the United Network for Organ Sharing, the 1-year survival rate after LT is 87.7%. A similar survival rate was achieved in the current study. It has been suggested that transplant outcomes improve with experience. In fact, it has been shown that outcomes for centers that have performed less than 20 transplants are poor.22,29,30 We divided our recipients into 2 transplant groups (n = 50 in each group) and compared their outcomes. There was a significant improvement in overall morbidity and grade 3A complications. A majority of other parameters also improved with increasing experience, although they did not reach significant levels because of a small number of complications. A nonsignificant reduction in 90-day mortality was observed in the latter 50 recipients.

A number of factors have previously been identified as potential obstacles to transplantation in Pakistan.1 We experienced a number of problems in the process of establishment and later sustainability. Table 8 demonstrates problems that must be addressed before a new transplant program can be started in a developing country.

### Need for Transplantation

It was very important for us to know if a LT program was really needed in Pakistan. Was there a sufficient burden of liver disease requiring transplantation? Indeed, this was true for the Pakistani population where the combined burden of HCV and HBV is close to 7% in the general population and up to 13% in high-risk individuals. More than 10 million people in Pakistan have HCV infection. The frequency of chronic hepatitis is also high in our country because of late access to medical care secondary to underlying economic factors.31,32

### Convincing Management of a Private Sector Hospital

LT requires a massive investment. It takes time to develop this service, and there are fears of poor outcomes in the beginning which can damage a hospital's reputation. A transplant program must only be established in a hospital that has provisions for multidisciplinary care and routinely performs complex surgeries. Intensive care, competent hepatology, and access to endoscopic interventions are a must. Stakeholders should have realistic expectations and be able to weather criticism in the initial phases of the program. There are only a handful of hospitals in Pakistan that provide multidisciplinary care to patients with a record in performing complex surgeries. Our task was further complicated because some of these hospitals were not ready to participate in such a financial investment, and in some centers, a transplant program could not be conceptualized because of the overall security condition of the city. We were fortunate to have interaction with Shifa’s administration, which promised prolonged and unconditional support. The hospital had developed a good reputation as a

<table>
<thead>
<tr>
<th>Obstacles</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Burden of need</td>
<td>Is liver disease a frequent problem Search local literature, statistics</td>
</tr>
<tr>
<td>2. Public awareness</td>
<td>Involve religious clerics, social workers, celebrities Electronic, print, and audiovisual media dissemination</td>
</tr>
<tr>
<td>3. Identifying the right hospital</td>
<td>Tertiary care hospital performing complex surgeries Self-sustained ICU, blood bank, radiology, gastroenterology</td>
</tr>
<tr>
<td>4. Funding limitations</td>
<td>Liaison with nongovernmental organizations and government</td>
</tr>
<tr>
<td>5. Lack of experience</td>
<td>Team leader with excellent exposure to transplantation Liaison with an international high-volume center</td>
</tr>
<tr>
<td>6. Sustainability</td>
<td>Incentivization Training opportunities Outcome assessment</td>
</tr>
</tbody>
</table>
tertiary care hospital in Pakistan. Renal transplantation was already in place, and complex general surgical operations were routinely performed. In short, we had a decent platform to launch our transplant program. Nevertheless, it took us 16 months before the first transplant could be performed. The hospital administration showed tremendous support in critical times and was always encouraging and optimistic.

**Team Leaders and Team Member**

A good transplant surgeon might be the most critical person on a transplant team; however, he alone is not sufficient. Regular meetings with leaders of other specialties in the hospital are important in order to identify their strengths and deficiencies and find solutions to their shortcomings. In addition, they should be well versed with different aspects of transplantation. A resilient team leader must be identified, and roles should be clearly defined. We had to devote considerable time initially in familiarizing our colleagues with the various aspects of transplantation and to make them commit a significant portion of their time to transplant activity.

**International Collaboration**

We also feel that a new transplant program in a developing country should have input from established centers. Our paramedical staff was sent to Global Hospital, Chennai, India, to gain exposure to various aspects of LDLT, and transplants in the early phase were performed with their collaboration.

**Educating Society to Develop Faith**

In developing countries, various social, cultural, and religious factors may prevent the general population from acknowledging transplantation as an acceptable treatment modality for ESLD. The population at large needs to be educated under supervision of religious clerics, social workers, and eminent celebrities. We were lucky that the people in Pakistan were generally aware and considered LDLT a viable treatment option for ESLD at the time of inception of our unit. Some had already travelled to India and China because these were cheaper treatment options compared to going to the West.

**Liaison With Funding Agencies**

In low- to middle-income countries, financial resources are limited. A majority of patients are poor and cannot afford a transplant, which on average would cost them $45,000. It is important to develop collaboration with various funding agencies and nongovernmental organizations to provide funds for needy patients. Initially, we had difficulty in arranging funds for patients in need of financial support. It was not easy to convince funding agencies to sponsor transplantation in Pakistan. However, once it began and our results were acknowledged in the mass media, finding financial support got much easier.

**Sustainability**

Once a transplant unit has been established, it is vital to ensure its sustainability. Members of the transplant team work selflessly to achieve desired results. It is important that they continue to work with the same enthusiasm. We did lose a number of our team members along the way. We feel that appropriate incentives at regular intervals to ensure improvements in performance are a must for the sustenance of a transplant program. The transplant program must strictly adhere to ethical guidelines if it wants to build a national and international reputation. We have not performed any transplants in nonrelated donors as per guidelines set forth by HOTA. To remain aware of recent advances is critical for improving outcomes. Medical and paramedical staff should have opportunities to improve their skills. Visits to other centers, attendance in relevant courses, and presentations at various meetings should be encouraged. In addition, junior doctors should be sufficiently trained to produce future transplant surgeons.

This study marks the successful development of a LT program in Pakistan. Outcomes comparable to international standards were achieved. Our center showed an improving trend in outcomes with growing experience. Developing countries face unique challenges in developing LDLT programs. They can be overcome with careful planning, role identification, and persistence. Studies with longer follow-up are required to demonstrate if comparable long-term outcomes can also be achieved in our population. Given the tremendous burden of ESLD in Pakistan, more centers need to acquire transplantation expertise.

**ACKNOWLEDGMENT**

We thank Mohammed Rela and acknowledge his efforts and continuous support in the inception of our transplant program.

**REFERENCES**


32. Parkash O, Iqbal R, Jafri F, Azam I, Jafri W. Frequency