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## 13. Living Related Liver Transplantation

### Living Related Liver Transplantation

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## Report

Liver transplantation is a successful and accepted procedure for the treatment of patients who have end-stage liver disease (ESLD). However, many ESLD patients succumb to their disease before receiving a liver transplant, because the number of patients needing transplants exceeds the number of donors. This shortage of donors is more acute for pediatric patients, especially for infants, due mainly to the relative scarcity of suitably small livers. To address the higher pretransplant mortality among pediatric patients with ESLD, procedures for reduced-size liver and split-liver transplants were developed and used with successful outcomes.(1-5) These results with partial liver transplants demonstrated that the transplantation of an appropriately sized segment of the liver can successfully restore full, normal liver functions without the need for a whole liver transplant.(6)

After the successful use of reduced-size liver transplants, the transplantation of a portion of a liver from a living related person into an ESLD patient was investigated. A successful transplantation of a portion of the liver from a mother into her child was accomplished in 1989.(7) Since then, other living related liver transplantations (LRLTs), in which a segment or lobe of the liver from the living donor is transplanted into a recipient, have been performed at a number of centers in several countries. In general, the outcomes in over 187 LRLTs, in terms of graft survival and patient survival, have been good. The number of LRLTs done and the observed patient and graft survival outcomes reported by various centers around the world are given in Table 1.

Although the number of procedures that were performed is small, all centers, except at Ankara,(10) reported good patient and graft survival outcomes that were comparable to or better than the outcomes with cadaveric livers. For example, Heffron et al(11) found that the patient survival of 14 LRLT recipients was 93 percent, with a graft survival of 93 percent compared with 83 and 69 percent, respectively, for patient and graft survival for 43 recipients of

cadaveric grafts. Katz et al(9) reported similar results of 89 percent patient survival and 78 percent graft survival in nine LRLT recipients compared with 90 and 90 percent, respectively, for 30 cadaveric graft recipients. Most of the LRLTs done in the United States were performed at Chicago(3) during the stay of Broelsch et al,(14) who reported that, of the first 20 LRLT recipients, 17 patients (85 percent) were alive 3-18 months postoperatively, for a 1-year actuarial survival of 82 percent. Fifteen of the survivors (75 percent) had their primary grafts, whereas two of the survivors had received retransplants with cadaveric livers when their grafts failed. After Broelsch returned to Hamburg, Germany, he and his associates performed a total of 36 LRLTs, with an overall patient survival of 72 percent.(8) The largest number of LRLTs have been and continue to be performed at Kyoto in Japan. One report from the latter group indicated that they performed 70 LRLTs by September, 1993, with very reasonable patient and graft survival outcomes.(12) A more recent report from this group(15) indicated that the number increased to 100 as of May, 1994, with continued good outcomes.

Most of the recipients of LRLT presented with ESLD due to biliary atresia (e. g., 80 percent of the recipients at Kyoto(12)), and a number of recipients had various inborn errors of metabolism, such as alpha-1 antitrypsin deficiency and Wilson's disease, as well as liver failures due to viral hepatitis or chemical toxins. Many of the early LRLT recipients were acutely ill, hospitalized, and in need of emergency liver transplants. On the other hand, most of the recent recipients were transplanted before they became acutely ill. This earlier transplantation appeared to be the result of the desire to allow sufficient time for the donor to consider adequately the risks and benefits of the procedure and assess the psychological impact of participation without having the pressure of imminent death as a dominating factor.(5) Thus, patients undergoing LRLT recently were in relatively better health than the usual liver transplant patients; this was thought to favor better patient survival outcomes. Observations such as those reported by Malago et al(8) and Tokunaga et al(12) appeared to support the better outcomes with the healthier recipients of LRLTs. For example, Malago et al(8) found that the patient survival of 30 relatively healthy LRLT recipients was 83 percent compared with 17 percent for six acutely ill LRLT recipients who had required emergency transplants. At Kyoto, Tokunaga et al(12) reported that the patient survival for the 54 elective LRLT recipients was 89 percent, whereas the survival for 16 emergency LRLT recipients was 69 percent.

The usual complications associated with liver transplantations, such as vascular thromboses, biliary leaks, rejections, and infections, have been experienced by recipients of LRLTs. From the available information, it is not clear whether the occurrence of complications or the outcomes with LRLTs

have changed with experience at the transplant centers. On the one hand, Lloyd et al(3) reported that most of the surgical complications occurred in the first half of the 45 LRLTs done at Chicago and that the patient survival and graft survival in the last 14 patients were 100 percent and 93 percent, respectively. On the other hand, there was no apparent difference between the survival rate for the first 20 recipients(14) and that for the total of 45 LRLTs (3) in the series; the rates were 85 percent and 87 percent, respectively. However, graft survival did appear to improve from 75 percent in the first 20 transplants(14) to an overall 88.9 percent for the total of 45 recipients.(3) At Kyoto, practitioners also found that the patient survival (85 percent) for the first 20 procedures(16) was essentially the same as that (84 percent) for the total of 70 LRLTs in their series.(12)

Parents or siblings of the patients served as the donors in almost all of the LRLTs performed. Although living donors have increased the supply of livers for pediatric patients, the use of healthy, living individuals for this purpose had raised some issues that needed to be addressed.(17,18) These involved questions concerning the exposure of a healthy person to the mortality and morbidity of a major surgical procedure and to potential psychological risks. Many of the centers that performed LRLTs indicated that these issues were addressed by the administration of thorough pretransplant medical and psychological examinations.(5,19) Preoperative medical examinations included a physical examination, blood analyses, liver function tests, and imaging procedures to determine the size of the prospective liver segment and to detect anomalies of the vasculature that may compromise the successful removal and reconnection of the blood vessels in the recipient.(5,10,20-22) Reports from some of the centers described psychological examinations that focused attention on an assessment of the donor for the presence or indications of possible psychological risks.(3,5,18,23) Lloyd et al(3) tried to minimize the pressures of an acutely ill patient by allowing approximately 2 weeks between the time of initial consent by the donor and the time of signing of the final consent for surgery, while the patient was in relatively good health.

All donors recovered from the surgical procedures without any notable complications. They returned to their pretransplant activities with normally functioning liver within a few weeks after spending approximately 1-2 weeks postoperatively in the hospital. For example, Lloyd et al(3) reported that all donors were alive and well at 2-year followup after an average stay in the hospital of 7.5 days. In general, the relatively minor complications, such as infections and bile leaks, that occurred in a few donors were treated and healed without any sequelae. Yamaoka et al(15) reported that, among the 100 parental donors who participated in LRLTs at Kyoto from June 1990 to May 1994,

there were four cases of bile leakage, one of esophagitis, seven of gastritis, and three of gastroduodenal ulcers. All of these donors returned to their normal presurgical activities within the first month or two after surgery.

As shown in Table 1, most of the LRLTs (151/187, or 81 percent) were performed at the three centers located in Chicago, Hamburg, and Kyoto, with 70 performed at Kyoto. The relatively good results with LRLTs at these and other centers may have reflected the performance of LRLTs at centers that had experience with reduced-size liver transplantations and had surgeons experienced in performing partial hepatectomies.<sup>(17)</sup> Although experience may have logically influenced the outcomes of LRLTs, as Broelsch et al<sup>(5)</sup> suggested, there is insufficient information available to determine to what extent, if any, such prior experience may be necessary at the transplant centers undertaking LRLTs.

As stated earlier, there have been no donor deaths reported in published accounts of LRLTs. However, in his brief discussion of liver transplantation, Hockerstedt<sup>(24)</sup> mentioned, without reference, that the first death of a living donor had occurred recently. Apparently, a donor died postoperatively as the result of pulmonary embolism (personal communication, R.P. Wood, University of Texas Medical School at Houston, 1995). This death did not appear to be the result of direct complications of the partial hepatectomy, but seems to represent a sobering reminder of the risk faced by any patient who undergoes any major surgical procedure.

In summary, LRLTs were performed successfully in a number of transplant centers with patient and graft survival rates that were as good or better than those with cadaveric livers. Practically all of the recipients have been infants or young children. With few exceptions, the donors of a segment of liver for transplantation were parents or other family members of the recipients. Of the approximately 200 LRLTs that have been performed, over 80 percent were done at three centers, with about half of the total performed at Kyoto. A considerable number of LRLTs were performed at two centers by teams headed by Broelsch while he was at Chicago and later, at Hamburg. It was reported that all donors recovered without sequelae and returned to their normal preoperative activities within a few weeks. Apparently, extensive medical examinations and some psychological evaluations were done preoperatively to assess the suitability of an individual to be a donor. What information was used for the selection of the donor was not clear from the publications. Similarly, a lack of information precludes the assessment of the possible influence of prior experiences of the transplant team with reduced-size liver transplantations and partial hepatectomies at the transplant centers on the outcomes of LRLTs. Whether these precautionary measures are in place at

all centers is not known, but the outcomes reported for the limited number of LRLTs from the centers other than those at Kyoto and Hamburg are encouraging. The performance of LRLTs on youthful patients who were in relatively good health may have contributed to the observed good outcomes.

*Health Technology Reviews* are brief evaluations of health technologies prepared by the Center for Health Care Technology, Agency for Health Care Policy and Research (CHCT/AHCPR) of the Public Health Service. Reviews may be composed in lieu of a technology assessment because: the medical or scientific questions are limited and do not warrant the resources required for a full assessment; the available evidence is limited and the published medical or scientific literature is insufficient in quality or quantity for an assessment; or the time frame available precludes utilization of the full, formal assessment process. This report has been prepared in response to a request from the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS). [↑ TOP](#)

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Technology Reviews](#) → [13. Living Related Liver Transplantation](#) → [Tables](#)**Table 1. Outcomes of living related liver transplantation**

Location of center	N	Transplant period	Patient survival (%)	Graft survival (%)	Followup period (months)	Ref no.
Chicago	45 <sup>a</sup>	11/89-4/92	87 <sup>b</sup>	89 <sup>b</sup>		3
Hamburg	36	10/91-4/94	83 <sup>c</sup> 17 <sup>c</sup>		.2-31	8
Houston	9	5/92-12/92	89 <sup>b</sup>	78 <sup>b</sup>	9-15	9
Ankara	6	3/90-6/93	33			10
Nebraska	14	7/92-7/93	93	93		11
Kyoto	70	6/90-9/93	89 <sup>d</sup> 69 <sup>d</sup>		12-36	12
Matsumoto	5	6/90-7/91	80	80	4-17	13
Total LRLTs	187	11/89-1/94	33-93	78-93	.2-36	

a Included seven LRLTs performed at Hamburg.

b Actuarial 1-year patient and graft survivals.

c Eighty-three percent survival of elective recipients; 17 percent survival of emergency liver recipients. Overall patient survival was 72 percent.

d Eighty-nine percent survival of elective liver recipients; 69 percent survival of emergency liver recipients.

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