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Split liver is an effective tool to transplant paediatric patients

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Abstract Transplantation activity is dependent upon organ procurement; although great efforts are made to enlarge the cadaver donors' pool, it still remains far too small to meet the recipients' need. Waiting time is a particular problem for paediatric patients, and mortality on the waiting list for liver transplantation is very high. The number of paediatric donors is far too small to satisfy the request. To enlarge the liver pool, the split-liver procedure was introduced in several Transplant Centers. In November 1997, the North Italy Transplant program (NITp) Working Group for Liver Transplantation decided to start an official Split-liver Program. A protocol was therefore defined and criteria for donor's and recipient's eligibility were established to minimize the risk. The Working Group also standardized the technical procedure and defined collaboration between centers. Out of 410 cadaver liver donors used in the NITp, from 1 November 1997 until 31 May 1999, 49 patients (37 males and 12 females) were chosen for the split-liver procedure. Mean age was 29.9 ± 17.5 years. Mean ICU stay of the donors was considerably short (2.5 ± 2.1 days), and the other conditions foreseen for donor eligibility were met. In all cases (except two) an "in situ" technique was performed. Forty-nine adult recipients and 43 children were transplanted by the split-liver technique in our Trans-

plant Centers. One right lobe and five left liver lobes were sent to Transplant Centers outside the NITp. Adult recipient age ranged from 18 to 60 years (mean 46.4 ± 11.7 years), and the paediatric one from 2 to 144 months (mean 24.8). Mean patient follow-up was 8.3 ± 5.5 months. In the paediatric group, the graft was successful in 34 cases (79%), five patients (10.2%) died and four (9.3%) were re-transplanted. In the adult group, graft survival was 67.3%, 11 (22%) patients died and 5 (10%) were re-transplanted. On 1 November 1997, 30 paediatric patients were on the liver waiting list. In the preceding 19 months, 52 patients were newly enrolled, and 36 transplants were performed. The mean waiting time of paediatric patients was 259 days (range 1–919 days). From 1 November 1997 to 31 May 1999, 61 paediatric patients were newly enrolled. In this period 70 patients were transplanted. The mean waiting time was 185 days (1–1010 days). At present, the liver waiting list includes eight paediatric patients. Split-liver transplantation is a successful procedure, effective in reducing waiting time for paediatric patients. It should be established if this may be a tool to enlarge the organ pool also for adult liver transplantation.

Key words Split-liver – Paediatric transplantation waiting list – Liver transplantation

Introduction

Transplantation activity is dependent upon organ procurement: great efforts are made to enlarge the cadaver donors' pool, but nevertheless it still remains far too small to meet the recipients' need. Waiting time is a relevant problem for patients of any age, and it becomes more important for paediatric ones, for whom size-matching difficulties are added [1].

Liver transplantation does not differ from other organ transplantation on this item. The number of paediatric donors is far too small to satisfy these requests, and the waiting time would be too long for very young patients, considering only this organ source. Moreover, mortality of patients on the waiting list is very high. It was therefore necessary to find other tools [4, 5, 7]: reducing the liver of adult donors or transplanting part of the livers from living donors.

Both these solutions present some problems: the first one decreases the pool of livers for adult recipients, the second one is not without risks for the donor, although they have been significantly reduced. A different procedure has therefore been introduced, splitting the liver into two grafts for two different recipients. The left lobe, comprising segments, II and III is usually for a paediatric patient, the right liver lobe with segments 4-8 for an adult one [6].

Patients and methods

The North Italy Transplant program (NITp)

The NITp is a transplant organization established in 1972 which serves an area with 18 million inhabitants, 48 procuring hospitals, 37 transplant centers located in 15 hospitals (12 adult kidney, three paediatric kidney, five kidney and pancreas, seven liver, six heart and four lung transplant centers) and 119 dialysis centers.

The NITp has a Reference Center in Milano, which manages the waiting lists, performs immunological evaluation of recipients and donors, allocates organs, organizes transports, collects data from transplant candidates, donors and grafted patients, sets up protocols with the operative units, develops information campaigns, provides psychological support to donor families and promotes research and development related to organ procurement and transplantation.

Split liver transplant program in NITp

In our Centers, split-liver procedure as described above has been performed since 1997. Until October 1997, only three adult donor livers were split, with three adults and three children being transplanted. In November 1997, the NITp Working Group for Liver Transplantation decided to start an official Split-liver Program. A protocol was therefore defined and the following criteria were established to minimize the risk linked to this technique: donor's eligibility was defined for an age preferably lower than 60 years, short ICU stay (less than 5 days), low inotropic support (dopamine < 5 µg per kg per min or dobutamine < 10 µg per kg per min,

no adrenaline or noradrenaline), normal ultrasonography and hematochemical evaluation.

With regard to the recipients, it was defined that if possible, urgent transplants should be excluded and informed consent should be requested.

The split liver procedure requires good collaboration between surgical teams. Thus a decision was made that the Center to which the liver is allocated should be free to decide whether or not to split the liver, and with which NITp Center. A split liver may be offered out of NITp's area if no compatible recipient is enrolled in the NITp list.

The Working Group has also standardized the technical procedure.

Donors

Out of 410 cadaver liver donors, used in the NITp from 1 November 1997 until 31 May 1999, 49 (37 males and 12 females) were chosen for the split-liver procedure. Although young donors are preferred, some older donors have been considered for the splitting procedure, taking into account good liver function and favourable conditions, such as short ICU stay or very low inotropic support. Mean donor age was 29.9 ± 17.5 years. Donor weight was between 14 and 100 kg with a mean of 53 ± 31 kg. This was relevant in the recipients' choice. The mean ICU stay of the donors was very short (2.5 ± 2.1 days), and the other conditions foreseen for donor eligibility were met.

Recipients

Except for two "ex situ" splitting procedures performed at the beginning of the program, in all other cases an "in situ" technique was performed. In 46 cases the right lobe was transplanted to an adult recipient and the left lobe to a paediatric patient. The livers of two donors were split each for two adults of small size, whereas a paediatric donor was chosen for two children; the last three cases required a modification in the liver division mentioned before: segment 4, normally belonging to the right split liver lobe, was given to the left lobe.

Forty-nine adult recipients and 43 children were transplanted by the split-liver technique in our Transplant Centers. One right lobe and five left liver lobes were sent to Transplant Centers outside the NITp.

Adult recipient age ranged from 18 to 60 years (mean 46.4), and the paediatric one from 2 to 144 months (mean 24.8).

Results

In the paediatric group, the graft was successful in 34 cases (79%), five (10.2%) patients died and four (9.3%) were re-transplanted. In the adult group, graft survival was 67.3%, 11 (22%) patients died and five (10%) were re-transplanted. Mean patient follow-up was 8.3 ± 5.5 months.

All NITp Centers collaborated in this program, although not in an equal manner. The most active Center performed 35 split-liver grafts out of 43 paediatric patients. Thirty adult recipients were transplanted with a split graft in one other Center which had contributed significantly to the program.

Collaboration between different NITp teams has always been very good, and in two cases teams from Italian Transplant centers not belonging to our Organization have successfully taken part in the procedure. The four left liver lobes sent out of Italy did not find a suitable recipient in our waiting lists.

The split-liver procedure did not interfere with the procurement of other organs from the same donors and it did not require an unacceptable increase in operating time, as described in the experience of some transplant Centers [3]. Furthermore, there was good compliance of the donor procuring hospitals.

On 1 November 1997, before split-liver program implementation, 30 paediatric patients were on the liver waiting list. In the preceding 19 months, 52 patients were newly enrolled and 36 transplants were performed (three of them were split-liver transplants). The mean waiting time of paediatric patients was 259 days (1–919 days). From 1 November 1997 to 31 May 1999,

61 patients were newly enrolled. In this period, 27 patients were transplanted with a whole organ while 43 received a split-liver. The patient mean waiting time was 185 days (1–1010 days). At present, the liver waiting list includes eight paediatric patients.

Discussion

Split-liver transplantation is a successful procedure [2], effective in reducing waiting time for paediatric patients and in increasing the number of liver transplants without affecting the chances of the adult patients. Since the size of the adult waiting list represents a major problem, the recent approach to transplant two adult recipients with a split-liver should be considered, in order to establish if this may be a tool to enlarge organ pool for liver transplantation.

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