SURGICAL COMPLICATIONS AFTER PEDIATRIC LIVER TRANSPLANTATION

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Liver transplantation (LT) is a major operative procedure with a maximal risk of surgical complications. Some of these are more specific of pediatric LT, such as hemorrhage in relation to graft reduction, or hepatic artery thrombosis (HAT). A number of surgical complications will require prompt reoperation with even the need for retransplantation. The incidence, nature, and consequence of such complications in a series of 111 consecutive LT’s in children are reported.

PATIENTS AND METHODS

In a little more than 4 years, between January 9, 1988, and March 20, 1992, 94 children received a total of 111 transplants at Bicêtre Hospital (France). Indication for transplantation included a majority of biliary atresia (BA) cases (57.4%). Operative technique included reduction of the graft (RG) in 64 cases (68%), and full-size graft (FG) in 47. Sixteen grafts were retrieved from donors whose weight was over six times that of the recipient. Hypoplastic portal vein (PV) was of particular concern in 8 cases. Arterial reconstruction was established with the recipient hepatic artery in 68 cases (61.8%) and via an arterial graft to the recipient infrarenal aorta in 42 cases (38.2%). One artery was not repaired because of overwhelming hemorrhage and death of the patient. Biliary repair was a choledocho-choledochal anastomosis in 7 cases, 4 of which were established without drainage. A choledochojejunal anastomosis was done in 106 cases, including 2 reoperated because of stenosis of biliary direct anastomosis. Immunosuppression included intraoperative steroids and azathioprine and subsequent tapered doses of both with adjunction of cyclosporine A. As six children died from immediate postoperative complications, data concerning reoperations were limited to the 88 children which survived the LT. Among the multiple postoperative investigations done for each patient, Doppler US and CT scan were the most valuable diagnostic tools for screening the complications.

RESULTS

Including 16 children submitted to retransplant (RT), 39 needed a reoperation, with a total of 62 procedures, and a number of 1 to 6 per patient. The majority of reoperations were undertaken during the first post-operative month on patients in intensive care unit, and laden with other comorbidities. The earliest indication for reoperation was abdominal bleeding which occurred in 10 cases for 9 children, 8 of which had a RG. One of these children died in spite of the reoperation. HAT occurred in 13 children, and twice for one child after...
retransplant. Surgical deobstruction was done in 4 cases, successful in 3 and not in 1. Seven HAT cases have been submitted to RT. Among the four children not reoperated for HAT three are awaiting RT, and the last one has a normal liver function. Four children developed thrombosis of the PV; surgery was effective in 2; one was retransplanted and one was not reoperated. This last child had spontaneous regression of esophageal varices, but persistence of major ascites, which he carried in fact before LT. Biliary anastomosis complications occurred in 15 children, 14 (15%) having been subsequently submitted to reoperation, with a total of 16 procedures. Seven children with biliary stenosis had suffered from HAT. A RT operation was done for 16 children, one of them needing a second RT. Thus the RT ratio was 18.6%. Beside the 8 cases of HAT, RT was indicated in 6 cases of primary non function of the graft (PNF), 2 cases of vanishing bile duct syndrome (VBDS), and one case of portal vein thrombosis. Other surgical complications include 7 cases of intestinal obstructions, associated in one case with recurrant perforations. Two children died because of the latter complications. Seven children had to be reoperated because of peritoneal collections consisting of bile, ascites or infected contents. Twelve children died in this series, six of them after reoperation including 3 RT's. Death occurred for all during the first week following reoperation except one ten months later, from intestinal infarction due to adhesions.

**DISCUSSION**

The large number (39/94 = 1.4%) of children requiring one or more reoperations after LT in this series is yet lower than reported in other series, such as those from Boston (65%)\(^1\).

The reasons for complications are multifactorial, with some specific aspects of pediatric LT. The preoperative condition of the child is frequently precarious in relation to the early decompensation of liver disease. Mean age for BA patients was 3 years one month, with 5 children aged less than one year at the time of LT. Acute liver failure occurred in 6 cases of that group, with the need for an emergency transplant in precarious conditions. Three of these patients died. RL grafts accounted for increase of bleeding during the reperfusion stage of the procedure, since blood loss evaluated in fractions of whole blood volume (WBV) were 4.5 WBV in RL's and 2.4 in FL's. Questions have been raised about the role of surgical technique in HAT\(^2\). The incidence of 12.6% in this series is similar or less to that observed in most pediatric series\(^3\). Although establishment of an arterial conduit from the recipient aorta was considered as a protective measure against thrombosis, 4 HAT (30%) occurred in these patients. Repeated screening by Doppler Us, followed immediately by angiography when doubt about HAT, has led to urgent deobstruction and reconstruction of the anastomosis in 4 cases of our series. Among possible causative factors, the conjunction of a small donor and a small recipient appears to create the major risk factor; five HAT were a complication of 21 LT's where both donor and recipient were under 15 kgs. Besides the small size, other factors such as prolonged hypotension, increased inflow resistance from rejection oedema, and reperfusion injury may have a role in the production of thrombosis. Mean time of HAT was 31.4 days post LT (range 2–150); seven occurred within the 2 first weeks. Late occurrence of HAT could be in relation to rejection. Consequences of HAT on liver parenchyma and biliary tract are variable and probably related to the date, and also the balance between arterial and portal flow to the liver. Severe liver necrosis was an indication to urgent RT in 2 children, whereas prolonged acceptable liver function and absence of extensive biliary infection allowed time for a non urgent RT in 5 other cases. Three children in this series are presently at home with an HAT; one of them has a normal liver function one year after LT and the two others are on the waiting list of RT. Obstruction of PV is a risk in BA patients with a minute PV: hepatofugal flow and diameter less than 4 mm are an indication to proceed to preoperative
angiography so as to determine the options for reconstruction of the portal tract during LT. The rate of PV thrombosis is high in some pediatric series, with emphasis on the hypercoagulable state following LT. Preventive measures include anastomosis of the graft’s PV on the superior mesenteric vein or on its junction with the splenic vein within the pancreas, avoidance of any kinking, unclotting just before unclamping. Checking for spontaneous portasystemic shunts so as to ligate the collaterals would theoretically help in increasing hepatopetal PV flow. A novel technique has recently been advocated, bridging the thrombosed portal vein by a venous graft interposed between the superior mesenteric vein and the intrahepatic terminal left portal vein.

"Achilles' heel" of LT has always been the biliary drainage from the graft. A relative ischemia of the donor duct may result from too low a section and poor irradiation of the distal part. In our series, biliary anastomosis complications were mainly in relation to HAT, and some reoperations were necessary during the waiting time before RT. Complications were mainly stenosis usually not associated with leaks; surgical correction was undertaken at periods varying from less than 3 weeks postop (6 cases) to up to six months. Reoperation was preceded by transhepatic cholangiogram and drainage guided by US. When biliary complications occur, delay in surgical repair may be expected since retention symptoms can be mistaken for rejection, while US screening test is late in demonstrating dilatation. Attempts with percutaneous dilatation were not successful as a rule and once responsible for partial disruption of the anastomosis. One cause for stenosis with duct to duct anastomosis was lateralization of the RG and its common duct not in line with the recipient's one.

The retransplantation rate in pediatric LT is high in most series. The 18% RT rate reported here is the same as others (1). An early RT operation done in time for PNF can be a swift procedure not requiring more than two or three hours, whereas a late RT for HAT may be the most tedious and lengthy operation with a major risk of bleeding and intestinal perforation. Urgent RT may carry the risk of severe rejection and/or progressive sclerosing cholangitis if an ABO incompatible graft had to be used. However, crossing the blood group barrier has been shown to be better tolerated in children under one year of age since natural ABO isoagglutinins or preformed antibodies reach the adult plasma level only at the end of the first year. Among indications for RT is the VBDS, where preformed lymphocytotoxic antibodies would have a part of responsibility. In the present series as in others dealing with LT, a cross-match test was not a routine procedure because of relatively short storage times; it was not performed before LT in the 2 cases of our series, both of which were treated by RT.

Abdominal infections may be a consequence of contamination during the LT operation, where accidental opening of the gut can be caused by extensive use of diathermy when freeing intestinal adhesions from the native liver. Such perforations occurred in 2 cases of our series, one of which appeared to be spontaneous at a distance from the operating zone.

CONCLUSIONS

An overall significant incidence of reoperations within the first weeks following LT is consistently reported, with a number of procedures per patient ranging from 1 to 6 or more. Attention to the early detection and management of these complications decreases morbidity and mortality. Yet the 41.1% ratio of reoperated children in this series include six ones which died in spite of reoperation for hemorrhage, retransplantation and intestinal complications. Certainly a "learning curve" has helped in lowering the risk of complications in the latest cases; yet even with growing experience, an unpredictable lot of risk factors remains, ranging from technical errors during retrieval of the graft, to uncontrollable bleeding from the cut surface of the reduced-size liver, not mentioning possible iatrogenic complications introduced during the post-
operative period in the intensive care unit. Economic considerations related to these complications must also be kept in mind: although LT represents a ratio of only 7.5% of the global pediatric intensive care in the ICU at Bicêtre Hospital, half of the expenses in blood products and 40% of those in drugs, are dedicated to the transplanted children, with an amount of working time from nursing staff approaching 20/24 hours per patient.

REFERENCES