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A new simplified technique of arterial reconstruction in pediatric living-donor liver transplantation: A comparison with the classical technique

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ABSTRACT

Background/Aim: Hepatic artery anastomosis (HAA) is the most important aspect of living donor liver transplantation (LDLT), and it is currently performed by a specialized microsurgeon using micro surgical techniques, with interrupted sutures and the aid of an operative microscope. To simplify the procedure, we studied a new, simpler technique performed by pediatric transplant surgeons with continuous sutures and the same 3.5× magnification loupe used during other transplant procedures. The aim of this study was to compare these two hepatic artery reconstruction techniques in two pediatric LDLT series.
Methods: This study was initiated in January 2010 and finished in June 2013. In the first period, the arterial reconstruction was performed with an operating microscope and the classical technique of 9-0 separate sutures. In the second period, the arterial reconstruction was performed using a simpler technique, with surgical loupe and continuous 8-0 Prolene sutures. The incidences and outcomes of complications within the two periods were analyzed and compared.
Results: A total of 82 LDLTs were performed, 38 in the first period and 44 in the second period. There were no differences between the periods, except for the arterial ischemia time, which was lower in the second period.
Conclusion: Hepatic artery anastomosis can be safely performed with low complication rates by a pediatric transplant surgeon using continuous sutures with a 3.5× magnifying loupe. This technique is simpler, less time consuming and simplifies the complex pediatric LDLT procedure.

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Hepatic artery anastomosis is still a challenge in living donor liver transplantation (LDLT) because of the technical difficulties related to the small diameters of the vessels [1,2]. It is the hardest and most important aspect of LDLT, and the incidence of arterial complications (i.e., stenosis or thrombosis) may reach 28% in large centers [3]. These complications are responsible for significant morbidity in post-transplant patients, as it may lead to a variety of consequences, such as hepatic failure and severe biliary complications [4].

Currently, this anastomosis is performed by a specialized micro-surgeon using micro surgical techniques, with interrupted sutures and the aid of an operative microscope. At the start of our LDLT program, we initially used operative microscopes (magnification 10–12×), but we have recently modified our technique. This change was prompted by our increasing experience in performing pediatric liver transplantation with magnification loupes.

To simplify the procedure, we prospectively studied a new, simpler technique that was performed by pediatric transplant surgeons using continuous suture and the same 3.5× magnification loupe that was used during past procedures.

The aim of this study was to compare the incidence of complications and operative time between these two hepatic artery reconstruction techniques in two pediatric LDLT series.

1. Methods

Our pediatric liver transplantation program was started in 1989 with cadaveric donors and in 1998, we performed our first LDLT. After twelve years of experience, we planned this study that was started in January 2010 and finished in June 2013. Since the beginning of the program, all donors have been operated on by the same team of pediatric surgeons [5], and all the recipient procedures have been performed or supervised by the same surgeon (the last author), including the arterial reconstruction. The data from the medical records of all patients who underwent LDLT in the period of study were collected.

A multidisciplinary team, including pediatric hepatologists, pediatric surgeons, psychiatrists, nurses and social workers, evaluated the patients preoperatively. After providing voluntary informed consent, the donors were evaluated by the same team. The following

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laboratory tests were performed: complete blood count, coagulation, electrolytes, renal function, liver enzymes, bilirubin, protein electrophoresis, urinalysis and serology for viral hepatitis, EBV, CMV, HIV, HTLV, toxoplasmosis, syphilis and Chagas disease. The donor candidates with normal test results were selected for donation. The left hepatic artery caliber and the presence of anatomical artery variations were evaluated using angiography with three-dimensional reconstruction of the vascular anatomy. The donor and recipient procedures were simultaneously performed in two juxtaposed operating rooms that were specifically adapted for these procedures. In a bench surgery, graft flushing was performed using HTK solution. Venoplasty of the hepatic vein orifices was performed as necessary.

The study was divided in two eras. The first period was started in January 2010 and finished in December 2011. The arterial reconstruction was performed with an operating microscope using the classical technique. From January 2012 until June 2013 (the second period), arterial reconstruction was performed using a simpler technique.

The incidences and outcomes of arterial thrombosis or stenosis within the two periods were analyzed and compared. Additionally, the following data were analyzed: the indication for liver transplantation, patient age and weight at transplantation, donor left hepatic artery caliber, presence of arterial anomalies in the donor and recipient, type of graft (left lateral segment or left lobe), arterial ischemia time, evolution and treatment of arterial complications and patient survival.

1.1. Surgical technique

For the recipients, the hepatic hilum dissection was performed according to the classical technique. The recipient right and left hepatic arteries were dissected high in the porta hepatis to maximize the arterial length and the reconstruction flexibility. The arteries were ligated and divided. This dissection was then carried proximally to the bifurcation of the proper hepatic artery and to the common hepatic artery, which was dissected and freed from its branches, the right gastric artery and gastroduodenal artery. The hepatectomy was then performed by preserving the inferior vena cava, and venovenous bypass was not utilized.

Two clamps were utilized to pinch the inferior vena cava at the supra and infra hepatic areas. The orifices of the hepatic veins were closed with continuous 5-0 Prolene sutures and a wide longitudinal incision at the anterior wall of the inferior vena cava was created. The created opening was large enough to be compatible with the size of the previously enlarged orifice of the donor hepatic vein. The liver graft was positioned normally, without any rotation, and a wide longitudinal anastomosis was easily performed using two long lines of continuous 5-0 Prolene sutures. After hepatic vein reconstruction, the portal vein was anastomosed to the trunk of the recipient's portal vein in an end-to-end fashion. The graft was reperfused after completing the portal vein anastomosis, and microsurgical reconstruction of the artery was then performed. The donor hepatic artery was always examined, and the appropriate size-matched recipient artery was used for the reconstruction in an end-to-end manner. Normally, the recipient right hepatic artery was chosen for the anastomosis.

Prior to performing the anastomosis, the donor and recipient arteries were flushed with heparinized saline solution, and fine vascular clamps were used to obtain proximal and distal control. In patients in the first period, the arterial reconstruction was performed using an operating microscope (model OPMI 6-SFC, Zeiss, Germany), with interrupted 9-0 monofilament polypropylene sutures (Ethilon; Ethicon Inc., Somerville, NJ, USA), according to the classical descriptions [5,6].

In patients in the second period, the arterial reconstruction was performed with continuous suture using 8-0 monofilament polypropylene sutures and a 3.5× magnification loupe (Designs for Vision, Inc., Ronkonkoma, NY, USA). A stay suture was placed at the right corners of the arterial ends (Fig. 1A). The other 8-0 monofilament polypropylene suture was then placed on the left corner of the wall of both the recipient and graft arteries; then the suture was continued to the right corner of the anastomosis. After finishing the anterior wall, the arteries were rotated 180°, and the anastomosis was completed with a running suture. The final knot was tied by hand leaving a growth factor of 3 to 4 mm. The vascular clamps were then removed to reestablish flow through the hepatic artery (Fig. 1B).

When the donor graft presented two left arteries with similar calibers, two anastomoses were performed: one using the recipient left hepatic artery and the other using the right hepatic artery. In one recipient, the intima of the hepatic artery appeared to be separated from the media, and dissection involved the entire artery until its origin in the celiac trunk. Therefore, a common cadaveric iliac artery interposition graft between the recipient aorta and the donor left hepatic artery was used. The anastomosis between the graft and the donor artery was similarly performed with 8-0 running sutures.

Postoperatively, all patients received continuous intravenous heparin 100 U/kg for 14 days because the international normalized ratio (INR) was ≤ 3.0, and anti-platelet aggregation started after the oral intakes began. A Doppler ultrasound evaluation was performed daily during the first postoperative week, every two days in the second week and once a week in the following two weeks. For a complete ultrasound examination, the arterial wave form and resistive index were considered for the final diagnosis of hepatic artery patency or thrombosis. Immunosuppression was achieved using tacrolimus and every child received methylprednisolone (20 mg/kg) at the moment of reperfusion of the graft. Corticosteroids were gradually tapered in the postoperative period to a maintenance dosage of 0.5 to 1.0 mg/kg of body weight/day. A third drug, mofetil micophenolate, was added solely in cases of repeated episodes of rejection or refractory rejection. Mofetil micophenolate or sirolimus was also used as single-drug immunosuppressants for patients with deterioration in renal function. OKT3 was administered to children

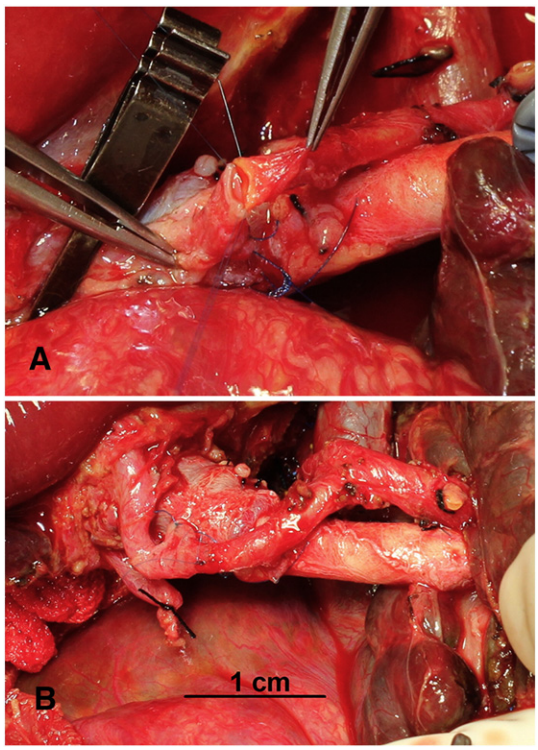

Fig. 1. A. Surgical aspects of arterial anastomosis. Note the stay sutures placed at the corners of the arterial ends. B. The anastomosis is completed. Note that the diameter of the artery measures 2 to 3 mm.