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Influence of systematic echodoppler arterial survey on hepatic artery thrombosis after liver transplantation in adults

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Abstract Hepatic artery thrombosis after liver transplantation remains a major problem which may lead to graft loss and retransplantation. Hepatic artery diseases were compared in two matched groups of liver grafted patients. In Group I (67 patients), echodoppler examinations of the graft hepatic artery were carried out after clinical or biological abnormalities became evident. In Group II (85 patients), echodoppler examinations were systematically made during the follow-up at 2 weeks, 1, 3, 6, and 12 months after liver transplantation. In cases of an abnormal echodoppler examination, arteriography was carried out in order to confirm hepatic artery stenosis and to perform endoluminal angioplasty. In Group I, echodoppler examinations revealed no arterial blood flow in three cases and reduction of hepatic blood flow in two cases. Hepatic artery thromboses were always confirmed by angiography, in the latter two cases, a collateral arterial revascularization of the graft was developed. In this group, two retransplantations, one choledocojejunostomy, and four percutaneous radiological biliary drainages were necessary. In Group II, echodoppler results showing a resistive index below 0.5 and a systolic acceleration time above 0.08 s involved 13 arteriographies. Ten stenoses were diagnosed without any biological abnormalities. Nine endoluminal angioplasties were made without any complication. There was no recurrence of stenosis. One pseudoaneurysm of the femoral artery was cured by compression. The early and non-aggressive detection of hepatic artery stenoses after liver transplantation by echodoppler allows treatment by angioplasty in order to prevent hepatic artery thrombosis and reduce retransplantation.

Key words Hepatic artery stenosis · Echodoppler examination · Percutaneous radiological angioplasty · Liver transplantation

Introduction

Vascular complications remain a major cause of morbidity and mortality after orthotopic liver transplantation (OLT) [3, 15]. The commonest vascular complication is hepatic artery thrombosis. This complication is reported to be between 2.5% and 9% in different series, with a higher incidence in children than in adults. Intraarterial angiography is a definitive method for diagnosing this problem. In fact, recent advancements in duplex sonography allow not only hepatic artery thrombosis to be recognized but also hepatic artery stenosis at the site of arterial anastomosis [2, 7]. As stenosis is probably the step before thrombosis, it could be interesting to detect stenosis in order to prevent hepatic artery thrombosis. At present, angioplasty is a very effective method for treating arterial stenosis [1, 4, 17]. The aim of the study was to assess whether systematic echodoppler examina-

tion may detect early hepatic artery stenosis and whether angioplasty of hepatic artery stenosis may decrease liver graft losses due to hepatic artery thrombosis.

Materials and methods

A total of 385 OLT has been performed at our center since 1985 [9]. Two non-randomized groups of patients were defined. In Group I, 76 patients were transplanted between 1993 and 1994. Of these, nine patients died during the postoperative 6 months, none in relation to a vascular complication, especially hepatic artery thrombosis, so 67 patients were studied in Group I. In this group, echodoppler examinations of the liver graft hepatic artery were carried out only in cases of clinical and/or biological abnormalities. In Group II, 94 patients were transplanted between 1995 and 1996. Nine patients died during the postoperative 6 months, none because of a vascular complication, so 85 patients were surveyed in Group II. In this group, echodoppler examinations were systematically performed during the follow-up at 2 weeks, 1, 3, 6, and 12 months after liver transplantation. Each sonogram analyzed the presence or absence of hepatic artery blood flow. The resistive index (RI), which was calculated as the ratio of peak systole to peak end diastole on the peak systole, and the systolic acceleration time (SAT), which is the time from the end diastole to the first systolic peak, were noted in the intraparenchymal distal right and left hepatic arteries. If RI was less than 0.5 and/or SAT was longer than 0.08 s a stenosis was suspected [6] (Fig. 1). Echodoppler examination was carried out again, 1–2 days later. If the doppler abnormalities persisted, an intraarterial digital subtraction angiography was carried out confirm arterial disease. Percutaneous transluminal hepatic artery angioplasty was attempted if an arterial stenosis involving more than 50% of the lumen of the vessel was confirmed by angiography. Both procedures were carried out at the same time. The stenosis was passed through with a hydrophilic guide wire (Terumo) then arterial dilatation was performed using a low profile angioplasty balloon with a size from 3 to 6 mm diameter (Schneider); it was possible to use coronaroplasty material if arteries were too winding.

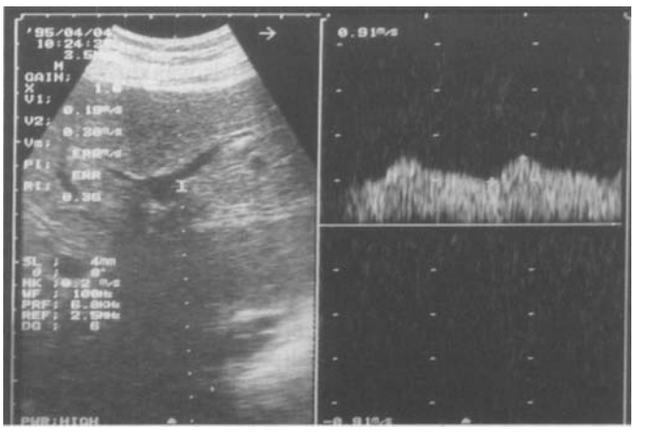

Fig. 1 Hepatic artery stenosis a few months after orthotopic liver transplantation. Echodoppler examination shows perturbed parameters in the distal hepatic arteries (resistive index = 0.36, systolic acceleration time = 0.14 s)

There were 67 patients in Group I and 85 patients in Group II. Both groups were comparable for age, sex ratio, indications for liver grafts, grafts rejection episodes, and arterial anastomosis types (Table 1). The transplantation procedure was the same in both groups. A piggy-back technique with conservation of inferior vena cava and temporary portocaval shunt was used for all cases. Arterial revascularization was performed first before portal revascularization, with the help of magnifying glasses [8, 10].

Table 1 The two matched population groups in the study (*OLT* orthotopic liver transplantation)

	Group I (1 Jan 1993–1 Jan 1995)	Group II (1 Jan 1995–1 Jan 1997)
Number of patients	76	94
Men	50	64
Women	26	30
Mean age (years)	47	45
Deaths before 6-month follow-up (excluded from the study)	9 of 67 patients	9 of 85 patients
Indications for OLT		
Alcoholic cirrhosis	22	28
Posthepatic cirrhosis	34	50
Other	10	7
Liver transplant rejection		
None	36	47
Corticosensitive	8	17
Non-corticosensitive	23	21
Arterial anastomosis		
With the recipient common hepatic artery	17	38
With the proper hepatic artery	38	30
With a right or left hepatic artery	7	10
With a common iliac artery	5	7
With the splenic artery	0	1
Backtable arterial reconstruction of the donor liver	4	9

Results

In Group I, hepatic artery thrombosis was diagnosed in five patients (7.4%). Three patients presented abnormal biological liver tests with septic syndrome and ultrasound examination showed no arterial hepatic doppler flow. Two patients developed an arterial collateralized vascularization around the hepatic pedicle after arterial thrombosis; one patient was totally asymptomatic and the other developed ischemic biliary strictures at the level of bile duct convergence. In these two cases, ultrasound examinations showed a persistent intrahepatic arterial flow but with perturbed parameters. RI decrease and SAT increase were noted. During the follow-up, four biliary percutaneous drainages were necessary, one intrahepatic cholangiojejunostomy was performed, and two retransplantations were carried out. No patient died during the follow-up.

In Group II, 13 sonograms suggested hepatic artery stenosis. RI was less than 0.5 and SAT more than 0.08 s. Only ten stenoses (11.7%) were confirmed by angiography. There were nine severe stenoses, narrowing more than 80% of the lumen, and one stenosis less than 50%. All these patients were asymptomatic without any biological abnormalities. In the other three patients, arteriograms were normal. No patient presented hepatic artery thrombosis in this group. Angioplasty was attempted in the nine cases of stenoses greater than 80%, with a mean delay of 4 months after OLT. There were eight technical successes with correction of sonogram abnormalities. The ninth stenosis was situated on a right hepatic artery leading from the superior mesenteric artery, the dilatation was not efficient but intrahepatic revascularization allowed the right liver arterial flow to be corrected. There was only one complication at the site of femoral artery puncture, a pseudoaneurysm of the femoral artery, which was cured by manual compression and the efficiency of compression was verified by echodoppler examination. There was no complication at the site of hepatic artery anastomosis dilatation. During the follow-up, one patient died after retransplantation from chronic rejection; there was no recurrence of stenosis and no arterial thrombosis detected by doppler with a mean follow-up from angioplasty of 1 year.

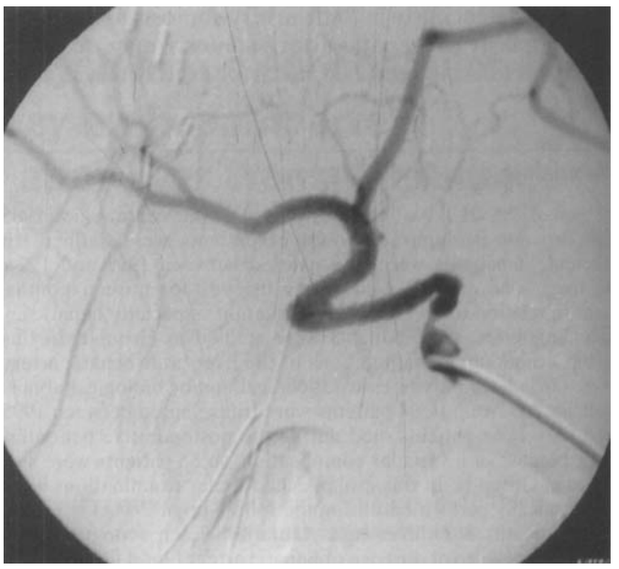

Fig. 2 Hepatic arteriogram helps to confirm the presence of a high-grade stenosis of the anastomosis

Discussion

Hepatic artery thrombosis is a serious complication after OLT. Early thrombosis is usually associated with liver cell failure, which frequently requires retransplantation. Delayed hepatic artery thrombosis is usually complicated by bile tree ischemic stenosis [5, 11, 20]. Hepatic artery thrombosis is multifactorial. Its prevention is based on ideal technical vascular reconstruction using magnifying lenses or the use of an operating microscope, the latter is recommended especially in pediatric liver transplantation. Microvascular suture instruments and atraumatic manipulation provide safe suturing. By adopting these procedures, we observed only one hepatic artery stenosis in the last 30 OLT carried out in 1997. A contribution of anticoagulants and/or antiplatelet aggregants to the prevention of stenosis was not demonstrated. Arterial reconstruction of the graft at the backtable does not seem to be associated with a higher risk of stenosis; in our experience we did not observe any stenosis on arterial reconstructions of the donor hepatic arteries. Stenosis were always seen at the site of anastomosis between the donor and recipient arteries (Fig. 2).

Hepatic artery stenosis might be considered as the first step to hepatic artery thrombosis. Hepatic artery stenoses usually progress to complete occlusion as a result of slow flow. A gradual onset of stenosis could induce the development of a collateral circulation leading from the hepatic pedicle arterioles and around the diaphragmatic vascularization area before the onset of arterial thrombosis. These collateral vascularizations could compensate for the intrahepatic hemodynamic pattern and procedure a doppler sonographic profile which is very close to that of a profile of stenosis. Nevertheless, intrahepatic hemodynamics created by collateral circulation can be deficient; this situation could remain asymptomatic or may lead to biliary tree ischemia.

The etiologies of hepatic artery stenosis after OLT are still controversial. Technical factors can be controlled by adopting microvascular atraumatic procedures for arterial anastomosis. Direct blood flow can

be obtained by direct hepatic artery reconstruction and avoiding anastomosis with hepatic artery collaterals. As stenoses are usually seen at the anastomotic junction between donor and recipient arteries, it might be postulated that traumatic manipulation of the endothelial lining can activate expression molecules of the major histocompatibility complex.

Initially, stenoses remain asymptomatic without any disturbance in liver functions and can only be detected through systemic doppler survey. This non-invasive examination is very efficient [13, 16]. Wider experience has been acquired in pediatric liver transplantation because of the greater risk of hepatic artery thrombosis [12, 18]. The measurement of RI and SAT parameters produced 97% sensitivity and 64% specificity [6]. Nonetheless, false-positive results are seen in cases of hepatic artery thrombosis associated with collateral hepatic arterial revascularization; in this situation the echodoppler examination is identical to cases of stenosis but the diagnosis is usually resolved by hepatic angiography. The incidence of false-negative results of echodoppler examination is difficult to estimate because we did not carry out systemic arteriography but it is probably rare because of the high quality of the material and the greater experience of the physicians.

As endoluminal hepatic artery angioplasty is usually efficient in the treatment of stenosis [1, 14, 17] but should we proceed to treat all of them? The question remains open. We chose to treat only prethrombotic stenoses evaluated as greater than 50%. The other stenoses are regularly followed up. Angioplasty can be performed safely [17, 19], the only complication observed was a pseudoaneurysm at the site of femoral puncture in a patient who aquired a coagulation factor IX deficiency due to the graft after OLT.

In conclusion, doppler ultrasonography is a simple, non-invasive method for detecting vascular complications in liver transplantation. Early detection of hepatic artery stenoses by measurement of RI and SAT allows them to be treated safely by angioplasty in order to prevent hepatic artery thrombosis. In consequence, it might be possible to reduce retransplantation and participate in the saving of liver grafts.

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