

Liver Transplantation Surgery: How We Do It Today In Italy

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Abstract

Background/Aims: Liver transplantation is probably one of the most challenging surgical procedures a surgeon can face. Since its pioneering time the technique of liver transplantation has dramatically changed evolving to the present form characterized by many different technical solutions that can be utilized to manage this complex surgery. The aim of this study is to report the result of a national survey regarding the surgical technique of liver transplantation in Italy. Methods: a questionnaire, focusing donor's liver harvesting and surgical technique of recipients' hepatectomy and graft implantation was emailed to all the 21 centers performing liver transplantation in Italy.

Results: Nineteen out of 21 (90.5%) of the centers completely fulfilled the survey. The results of this national survey showed an important variability of the surgical techniques utilized by different centers, reflecting the evolution of liver transplantation from its ancestor time and the adaptation of novel surgical techniques together with innovative intraoperative technologies.

Conclusion: The secret of this operation, as for all surgery, is to have complete mastery of the anatomy to avoid wandering into places or structures where one is not supposed to be and of all the surgical techniques available to face any possible situation during this high challenging surgery.

Keywords: Liver; Transplantation; Surgical technique; Liver harvesting

Introduction

According to conventional clinical and surgical standards of the early 1960s, removing a diseased liver and replacing it with a healthy one was a concept that had little chance to be successful [1]. Just thanks Thomas E. Starzl's technical brilliance and stubborn perseverance the surgical procedure of liver transplantation developed into the refined surgical procedure we know today [2,3]. In these pioneering times, the fastest procedure took fourteen and a half hours and only cases lasting longer than twenty hours were considered poor from a technical point of view. Since then, innumerable improvements have been made, each one making a small contribution that, as a whole, have transformed today's liver transplant procedure into an evolutionary descendant that barely resembles its ancestor [3]. Liver transplantation today is performed principally by two different techniques: the classical technique with vena cava interposition [4] and the piggyback technique that leaves the native cava behind [5]. The reality of liver transplantation in Italy is wide. Twenty-one liver transplant centers (one every about 3 million people) are spread around the country and 3 inter-regional OPOs and 1 National Transplant Centre coordinate this activity. The aim of this paper is to proceed to a national survey of the surgical techniques of liver harvesting and transplantation around the country.

Material and Methods

A simple questionnaire was e-mailed to the surgeon in charge of every liver transplant center in Italy. The questionnaire consisted of two sections: one regarding the surgical technique of liver harvesting including type and amount of preservation solutions and one focusing on the surgical techniques including hepatectomy and reconstruction phases, types of graft reperfusion and closure of the abdominal incision. Details were requested about surgical incisions, veno-venous bypass or porto-caval shunt, venous outflow techniques, portal vein, hepatic artery and bile duct reconstructions (types of stitches, use of surgical loupes for magnification). The use of T-tube was investigated too. The questionnaire that was e-mailed to all centers is shown in table 1.

• Liver harvesting:
• Type and amount (ml/kg) of conservation solution used
• Type of liver perfusion in situ
• Type of liver perfusion at back-table
• Liver transplantation technique:
• Type of surgical incision
• Technique of hepatectomy
• Use of veno-venous by-pass (surgical or percutaneous)
• Use of porto-cava shunt
• Type of outflow anastomosis
• Type of portal vein reconstruction
• Type of hepatic artery reconstruction
• Type of bile-duct reconstruction
• Use of surgical loupes for vascular anastomoses
• Use of intraoperative ultrasound flow measurement
• Use of the T-tube
• Use of an internal biliary stent
• Type of in situ wash-out of the graft
• Type of reperfusion of the graft
• Number of surgical drains positioned
• Type of reconstruction of the abdominal wall

Table 1: Questions of the survey

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Results

The questionnaire has been e-mailed to the surgical Director of all Liver Transplant Centers in Italy, i.e. 21. Nineteen out of 21 (90.5%) of the centers completely fulfilled the survey and returned it. The Celsior solution is the preferred one for liver in situ flushing in 61% of the centers, while 39% used University of Wisconsin (UW) solution; Celsior is used at a mean volume of 100 ml/kg and UW at 70 ml/kg. The preservation solution is flushed to the liver, in situ, through the abdominal aorta in 61% and through the aorta and portal vein in 39% of the centers. During back-table preparation the liver is re-flushed through the portal vein and bile duct in 34%, the hepatic artery and bile duct in 22%, the portal vein, hepatic artery and bile duct in 22% and through the portal vein only in 22% of the centers respectively. Back-table bile duct flushing was undertaken by 78% of the centers. The type of incision is Mercedes-like in 61%, J-shaped in 33% and right sub-costal in 6% of the centers. In 88% of the centers the hepatectomy is performed by the piggyback technique with retrohepatic vena cava preservation (Figure 1) and in 12% by the classic one; only 1 centre (6%) uses routinely the veno-venous by-pass. Routine temporary porto-caval anastomosis during hepatectomy is never used. As for the implantation techniques, 39% perform the outflow anastomosis on the

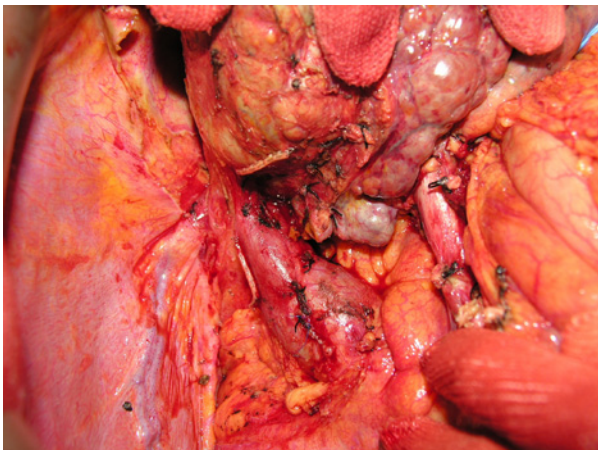


Figure 1: Hepatectomy performed by the piggyback technique with retrohepatic vena cava preservation.

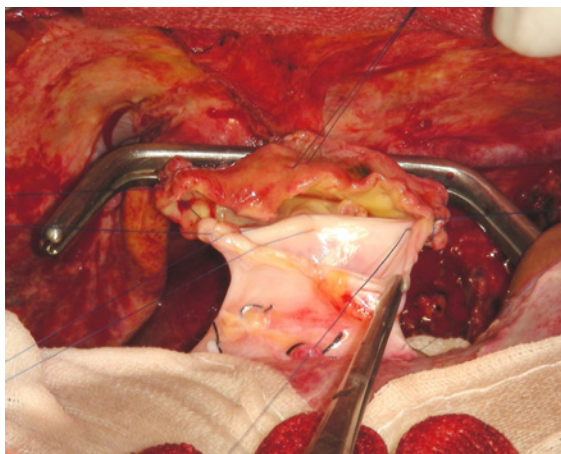


Figure 2: outflow anastomosis on the cuff of the three hepatic veins.

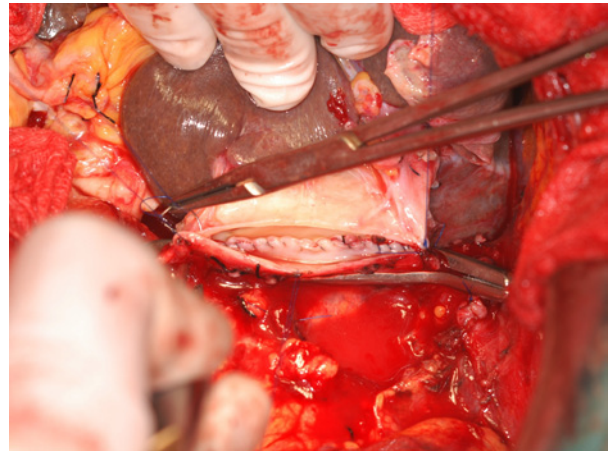


Figure 3: Outflow anastomosis performed by latero-lateral (L-L) modified Belghiti technique.

cuff of the three hepatic veins (Figure 2), 28% use the latero-lateral (L-L) modified Belghiti technique [6] (Figure 3), 16% a termino-lateral (T-L) Belghiti technique and 6% use the cuff of the left and median hepatic veins. Two centers remove the retrohepatic vena cava during hepatectomy (classic technique) and perform the outflow reconstruction by two termino-terminal (T-T) suprahepatic and infrahepatic cavo-caval anastomosis. The portal vein is always reconstructed by T-T technique with growth factor and in 61% of cases with the aid of surgical loupes. The hepatic artery is reconstructed on the graft's side at the level of the gastroduodenal artery in 65%, of the proper hepatic artery in 23% and of the splenic artery in 6% of the centers; 6% of the centers reported a variable technique of hepatic artery reconstruction; surgical loupes are used in 82% of cases and the microscope is never used routinely. The bile duct is reconstructed by a T-T duct-to-duct anastomosis in all centers. Only one centre report the preference for hepatico-jejunostomy for HCV positive cases. The duct-to-duct technique is performed by single continuous suture in 55%, interrupted sutures in 27% and posterior wall by continuous suture while anterior wall with interrupted sutures in 18% of the centers. The duct-to-duct is routinely splinted by a t-tube in 61% of the centers, 27% never use a t-tube and 12% use the t-tube only in case of size discrepancy between the donor's and recipient's ducts. The liver is flushed by saline plus albumine solution in 33%, ringer's lactate in 33% or recipient's blood in 27% of cases before revascularization. In one centre the graft is not flushed before revascularization. The liver is revascularized through the portal vein in 61%, retrograde through the hepatic veins in 28% and simultaneous portal and arterial in the remaining 11% of the centers. Fifty percent of the centers leave two drains, 33% three drains, 11% one drain and 6% four drains. Abdominal closure by layers with running suture is performed in 61%, single layer by running suture in 17% and by layers (running suture for the peritoneum and interrupted sutures for the fascial layers) in 22% of the centers respectively.

Discussion

The surgery of liver transplantation developed by Thomas Starzl in the sixties has basically remained the same during the years except for the introduction of the caval-sparing (piggyback) technique by Tzakis et al in 1989 [5]. Since then, many technological achievements have been developed to facilitate this difficult operation [7-9]. However, the recipient procedure, including the removal of the diseased liver and the implantation

of the new graft with vascular and biliary anastomoses, is one of the most challenging a surgeon can face.

The reality of liver transplantation in Italy is wide. Twenty-one liver transplant centres (one every about 3 millions people) are spread around the country; approximately one thousand liver transplant procedures are annually performed in Italy (<http://www.trapianti.salute.gov.it/>), with a wide variety of procedures performed yearly in different centers (from 16 up to 133). More precisely, over a 10 years period (2000-2009) a total of 9,470 liver transplants have been performed in Italy (<http://www.trapianti.salute.gov.it/>). Seven centers did more than 50 cases/year, 9 centers performed 25 to 50 procedures per years and 5 centers did less than 25 cases yearly. In spite of this large variety of activities, the one-year results in terms of patients and graft survival did not vary significantly between centers, ranging respectively from 85% to 82% and 82% to 79% in high volume centers (>50 transplants per year), 87% to 75% and 84% to 70% in medium volume centers (from 25 to 50 transplants per year) and 86% to 77% and 84% to 75% in low volume centers (less than 25 transplants per year) (data form Italian National Transplant Center <http://www.trapianti.salute.gov.it/>).

The aim of this study is to perform a national survey of liver transplantation surgical techniques and try to define the grade of variability among the centers.

The first part of the questionnaire briefly analyses some of the aspects of the harvesting technique (preservation solutions, in situ and ex situ graft's flushing methods). The Celsior solution is more used than the UW and requires higher amounts. In situ flushing at cross-clamp is most commonly done through the aorta only, but a considerable number of centres flush the liver in situ also through the portal vein, reflecting probably the increasing amount of marginal livers utilized and the need to optimize flushing and preservation by combined arterial and portal perfusion as reported in the literature [10]. The method of washing the graft at back table is characterized by a wide variety of approaches, and most of the surgeons (78%) are in accordance with flushing the biliary tree in order to better preserve its integrity [11].

The second part of the questionnaire focused on the recipient procedure starting from the surgical incision, which may be influenced by previous surgery, size and shape of patient and liver, or other factors [12]. The Mercedes-like incision, a bilateral subcostal incision, is the most commonly used followed by the J-shaped approach basically avoiding the left sub-costal extension [13]. Eighty-eight % of the responding centres perform the hepatectomy with the caval-preserving "piggyback" technique, maybe reflecting an attitude towards the avoidance of the veno-venous by-pass, with only one center routinely using it. Interestingly, none of the centers in Italy perform liver transplantation using a temporary porto-caval anastomoses differently from what happens in many other countries where the temporary porto-caval shunt is widely utilized [14]. As for vascular anastomoses, there are a wide variety of techniques for outflow reconstruction; nonetheless the tendency by all surgeons investigated, irrespectively of the type of technique used, is to create an anastomosis as wide as possible in order to optimize the outflow of the graft [15]. The portal and arterial anastomoses are usually done in a similar way by all the centers. Particularly, the trend is toward the use of a growth factor technique for portal vein reconstruction and to avoid the use of the Carrel's patch for arterial reconstruction, performing the anastomoses more proximally to the graft's common or proper hepatic artery. This is probably due to the frequent use of old donor affected by severe atherosclerotic lesions of the aortic Carrel's patch and the will to avoid long artery that may result in kinking problems [16,17]. Interestingly, no one uses the microscope for arterial anastomosis but 82% perform it with the aid of surgical loops [18].

The biliary reconstruction is routinely performed by all centers by a T-T duct-to-duct anastomosis, while no consensus exist in the method of suture, with half of the centers doing it by running sutures and the others by interrupted or a combination of running and interrupted sutures. The T-tube is routinely used by more than half (61%) of the centers probably reflecting one time more the nature of old and extended criteria donors utilized in Italy [19]. The sequence of liver reperfusion is in 61% of cases through the portal vein first, but some centers are now reperfusing the graft by simultaneous arterial and portal blood [20]; the retrograde reperfusion is still used by 28% of the centers [21].

All the centers put at least one surgical drain, with most placing two drains at the end of the procedure. The most common method of closure of the abdominal wall is by layers with running sutures; fascial closure with interrupted stitches is still performed by 22% of the responding centers.

Conclusion

The secret of this operation, as for all surgery, is to have complete mastery of the anatomy to avoid wandering into places or structures where one is not supposed to be. Even the most minute, careless move can have a devastating impact on the outcome of liver transplantation. Nothing supplants experience and technical expertise for the final result.

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