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## Right-side approach to the left caudate lobe in the piggy-back technique of liver transplantation. A further step in maximizing preservation of the retrohepatic inferior vena cava

Dear Editors:

The technique for orthotopic liver transplantation (OLT) has been well standardized over the past decade. The classic procedure, which included the use of a veno-venous bypass, has recently been replaced at several centers by the so-called piggy-back technique [4]. This latter procedure allows surgeons to perform OLT while preserving the retrohepatic inferior vena cava (IVC), avoiding the bloody dissection of the retrohepatic space, the use of the aforementioned bypass, and the performance of inferior IVC anastomosis.

In 1996 we published the results of a controlled randomized trial on the effectiveness of the piggy-back technique [3]. Among the criteria that we identified as contra-indications for the use of this technique, the anatomical ones were the most consistent [3].

In fact, marked hypertrophy of the left portion of the caudate lobe induced by cirrhosis can give rise to an exuberant growth of some portions of this hepatic segment, with the final aspect of the IVC being completely surrounded by liver parenchyma, even in its posterior aspect, from the left side to the right. In more advanced cases of hypertrophy of the left portion of the caudate lobe, the posterior ligament of the IVC (the so-called Makuuchi ligament) can also be completely replaced by some portions of hepatic parenchyma, which thus surrounds the vessel by 360°. It is important to note that replacement of the posterior ligament by hepatic tissue occurred in up to 50% of cirrhotic patients [1].

Isolation of a very hypertrophied caudate lobe from the IVC renders the piggy-back procedure time consuming and technically demanding. In our report we therefore recommended that the technique not be applied under the above circumstances and that the procedure be switched to other alternative and safer techniques which could include complete removal of the retrohepatic IVC [3].

Our original approach to the piggy-back technique suffered from the experience that we had acquired in performing conventional liver resections. With some partial hepatectomies, usually those performed in non-cirrhotic patients for Klatskin's tumors or for tumoral masses located in the caudate lobe, full isolation of this segment of the liver is mandatory. After full mobilization of the right lobe and exposure of the IVC, the caudate lobe is initially approached from the right side of the IVC with the transection of the posterior ligament, which represents a key point in the procedure. Only after this step can attention be turned to the left portion of the caudate lobe on the left side of the



**Fig. 1** Right-side approach to the hypertrophied left portion of the caudate lobe surrounding the inferior vena cava. The liver is completely turned to the left. A small retractor on the IVC, without occlusion of the vessel, allows easier isolation and sectioning of the small accessory veins coming from the posterior aspect of the caudate lobe (*RHV* right hepatic vein, *PL* posterior ligament of vena cava, *CL* caudate lobe, *IVC* inferior vena cava)

IVC. After the right lobe has been repositioned in its natural place, the peritoneum above the left side of the inferior IVC is sectioned and the caudate lobe carefully and slowly detached and freed from the vessel, in a caudal-cranial direction. This approach requires full rotation of the operating table to the right side of the patient and an awkward approach to the area bordered by the left side of the IVC, the caudate lobe, and the stomach.

During the past 2 years the approach to a highly hypertrophied caudate lobe during OLT has changed substantially, due to the persistence of a number of procedures that still require switching of the technique. OLT is started in the usual manner, with full mobilization of the right lobe of the liver and isolation of the lower portion of the retrohepatic IVC from the distal part of the caudate lobe. As soon as the dissection proceeds towards the cranial portion of the vessel, its posterior ligament is encountered and transected in the usual fashion. Only at this point is it possible to recognize

fully the presence and magnitude of the left portion of the caudate lobe, which protrudes into the space between the posterior surface of the IVC and the lower portion of the diaphragm. The dissection is then continued first on the virtual plane existing between the most posterior aspect of the caudate lobe and the diaphragm, which usually requires easy transection of a few adhesions. Experience in liver surgery, and in particular, in the isolation of the IVC above and below the liver to apply total vascular exclusion, makes this step easier [2]. Great care must then be taken in separating the hypertrophied caudate lobe from the IVC, which can include isolation and sectioning of some accessory hepatic veins coming from the posterior surface of the caudate lobe that can vary considerably in diameter. This dissection is more easily performed with gentle apposition of a small-tomedium-sized retractor on the IVC, without any occlusion of blood flow (Fig. 1).

The dissection of the two planes is conducted, as far as is reasonably and safely possible, toward the left side of the IVC, without adding more difficulties to the procedure itself. Only at this point is the liver twisted back to the right side and attention focused on freeing the left side of the IVC from its real left side. At this time the caudate lobe can usually already be somehow separated from the vessel, and its remaining portion detached from the anterior portion of the IVC in a manner that is safer and more convenient for the surgeon. Thanks to this approach, even in the case of a hypertrophied caudate lobe completely surrounding the IVC, we can achieve the advantages of the piggyback technique in the operating time and reduction of blood loss already described [2]. During the past 2 years this technique has been applied in 15 cases of very hypertrophied caudate lobe. By using this approach we did not observe any increase in operating time, anhepatic time, or bleeding, compared with cases with non-hypertrophied caudate lobe. Furthermore, we did not observe stenosis or compression of the native IVC in any case.

This small modification to the original technique can be applied in all cases of marked hypertrophy of the caudate lobe that no longer should represent a contra-indication for the use of the piggy-back technique. As far as this approach is concerned, the only reasons not to perform the piggy-back technique are re-transplantations due to IVC outflow complications and surgical alterations of the retrohepatic IVC that occurred incidentally during hepatectomy. We believe that this is a better approach than the earlier description of the piggy-back technique and that it may be applied in all recipients.

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