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Surgical anatomy of the liver in the 3D image era

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Recently, the early detection rate of HCC has increased to 50%, and along with the need for limited liver resection and the increase in minimal invasive surgery, preoperative 3D reconstructed images of the liver are believed to be important to increase the success rate of anatomical liver resection. I also think that simulation through preoperative 3D reconstructed images can play a very important role in living donor liver transplantation. In this lecture, through seven years of experience using 3D reconstructed images in liver surgery, I would like to emphasize that in modern liver surgery, 3D reconstructed images are not just a tool that is good to have or not without any problems, but an essential tool. Couinaud's eight-segment scheme, despite its usefulness and simplicity, can serve as a dogma that divides liver in a man-made fashion. In general, liver has a constant first and second order inflow branches that divides the organ into two hemilivers and four sections which have watershed plane where the hepatic veins are located. However, this schema of anatomical description, renders or even preclude inflow-oriented anatomical liver resection as it neglects the variation of inflow vessels in terms of number of branches and sliding of origins, especially its third order inflow branches.

In the left liver, the third order portal pedicles have an anatomical variation of "number of branches". Therefore, anatomic liver resection is always easy in the extrafascial approach. However, in the right liver, it is frequently difficult for us to do an anatomical monosegmentectomy, because their variation patterns are "sliding of origin" as well as "number of branches". Therefore, I had applied the transfissural approach, more invasive approach, in the right monosegmentectomy for enhancement of success rate of anatomical resection before 2016. After 2016, I could use the 3D reconstructed images of the liver, and I have applied the adequate techniques in the anatomical monosegmentectomy according to the individual anatomical patterns of the third order branch. And we analyzed the variation of the third order inflow branches of the RAS and RPS in 96 liver donors from 2017 to 2018. I will show you its result in this presentation.

Before 2016, a strictly controlled anatomical resection of segment 7 and 8 can be performed in only about half of the patients using usual techniques. However, given that 3D reconstructed image is preoperatively available, a higher success rate of anatomical

resection can be achieved by designing the resection plane according to the individual anatomic variation.

Even in the case of liver transplantation, 3D reconstructed images are very useful. When using a preoperative 3D reconstructed image, intuitive anatomical variation can be found and the liver volume of the hepatic vein territory as well as the portal vein territory can be accurately measured. In particular, in living donor liver transplantation using a right lobe graft, it not only accurately informs the volume of the right lobe, but also accurately informs the volume of the congestion area of the anterior segment and the volume of the right hepatic vein territory to determine the degree of need for reconstruction of the middle hepatic vein. In addition, in volume-based right posterior section graft - LDLT, previously used semiautomatic programs for donor evaluation considered the ventral margin of the posterior section as RHV, but in the 3D reconstructed image, the actual territory of the right posterior portal vein can be more easily and accurately obtained. Using recent 3D imaging techniques, it is possible to very easily and accurately determine the anatomical information of a donor liver in LDLT.

Although there are people who have not used 3D image of the liver in liver surgery, there is no one who uses it only once and then never uses it, I think.