4) Other useful analytical tools for liver cancer surgery

The PET/CT viewer may be useful to improve the detection of very small lesions. Comparison of 3D images over time, real oncologic imaging, making it possible to automatically analyze tumor changes during treatment according to different criteria: RECIST criteria for all tumors and mRECIST for hepatocellular carcinomas.

C – Requirements or restrictions

Synapse 3D is a solution designed to automate the 3D and volumetric analysis of the liver.

To extract and model the entire vascular structure, the acquisition of images in the arterial phase between 18 and 25 seconds and in the portal phase between 50 and 70 seconds is recommended.

A 3d series of images (equilibrium phase) may be useful 3 minutes from the initial injection. This however is rarely asked, unless doubt persists regarding an angioma.

If combining MRI and CT images is desired, it is advised to acquire images in the same respiratory phase, ideally in expiration, to obtain best quality results.

The diameter of the arteries is largely underestimated because the lumen in the injected blood vessels is taken into account while the surgeon sees the outer wall of the blood vessels which doubles or triples the diameter for better appearance. The settings can perform any necessary adjustments.

We recommend that the surgeon focuses particularly on the vascular reconstructions possibly performed by a junior surgeon.

In fact, we determine our procedures and approach to the hilum of the liver based on the modeling performed with Synapse 3D.

Our low intraoperative laparoscopic bleeding complication rates, or our extremely low conversion rate won’t make us go back anymore.

c) Overall, all excisions can be simulated in the axial views or in reconstructed volumes. The focal attack of a wedge-shaped piece of liver tissue, the thickness of the resection margin, the surface of the slice or field plane can be all be modified and validated in the native images. Last but not least, the prospective remaining hepatic volume is calculated with every change (FRL).

d) The work and resulting images can be saved in image format at any time. Once the analysis is complete and the liver reconstructed in 3D, the processing can be saved in any file format such as PDF 3D or STL. These files are easy to send as attachments by e-mail, and can be printed automatically in 3D.

*Specifications are subject to change without notice.

All products require the regulatory approval of the importing country. For details of availability, contact our local representatives.
After placing the trocar in the proper axis, Synapse 3D makes it possible to identify the distances on the skin’s surface from the umbilicus or edge of the ribs. We can then simulate the organ’s resection to properly determine the surgical risks.

2) The liver analysis tool

The viewing of a 3D liver with its blood vessels in addition to one or several lesions is mainly automatic.

a) The first step of the analysis is the liver extraction process, which is best performed from the portal or equilibrium phase images of the CT scan; a combination of CT scan and MRI images is also possible and extremely useful for the analysis and location of bile ducts or tumors, especially with a metastatic growth which is more visible in the MRI than in a CT scan. The option to integrate the slices from the diffusion MRI makes it possible to differentiate actual missed metastases (invisible to the scan and MRI) from those which responded well to chemotherapy but still remain, even if minimally. This is all the more useful since missed metastases are often also invisible in a standard intraoperative ultrasound.

b) The second step is the extraction of the hepatic artery, the portal vessels and the hepatic veins with their branches from the portal veins, the right hepatic vein and the hepatic veins or tumor. The extraction of the vena cava and gallbladder is semi-automatic. Therefore, after validation imposed by the software of the origin or termination of the various vessels, the liver is fully reconstructed automatically in 3D. The bile ducts, if dilated, can be easily traced on axial slices, otherwise they can be extracted from an MRCP (Magnetic Resonance Cholangiopancreatography) that Synapse 3D will merge.

3) The benefits of a liver’s analysis for the surgeon

a) The first benefit of this software is to improve safety by very easily locating the anatomical variations. These are very important for the surgical procedure: the emergence of the portal veins or arteries, their branches and sliding, or not, downward or leftward in the extrapleural or intrapleural ducts. Still the number and site of the hepatic veins in particular the presence of 1 or 2 median hepatic veins, the exact site of drainage of the portal vein if a right hepatectomy or a segmentectomy is required, the crossing of the epiploic or hypoportal bile ducts, or in front or behind the right anterior vein for example, etc. In fact the variations are countless and, especially for, but not only, a young clinician, the added value of a quality reconstruction is priceless.

Here are several examples of anatomical variations that are potentially dangerous. Arterial changes: Figure 5A and 5B

Changes in the portal veins are just as numerous and risky (Figures 6A, 6B, 6C, 6D), while changes in the hepatic veins increase the risk of injury to the inferior vena cava (Figures 7A and 7B).