Liver Tumor Ablation Assisted by Image Fusion

CME Credits

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Image fusion has evolved into a relatively mature option for high-end ultrasound machines, with many manufacturers offering various options. The names of these machines highlight the nature of their function: for example, real-time virtual sonography (Hitachi), volume navigation (GE), PercuNav (Philips), and Smart Fusion (Toshiba [Canon]). These machines input three-dimensional spatial imaging data from a region of the body obtained from computed tomography (CT) scans into an ultrasound device, relying on positioning to find the correct starting point (also known as "registration"). A sensor on a probe detects the probe's movement, and the machine displays on its screen real-time ultrasound images and the reference virtual CT images together in the same plane. In other words, during ultrasonography, the machines simultaneously display CT images obtained from previous examinations concurrently with real-time ultrasound images [Figure 1]. In addition to CT data, some machines can also provide magnetic resonance imaging (MRI), ultrasound, or positron-emission tomography (PET) as reference volume.

Fusion imaging is most often used in the treatment of disease foci that can be detected via CT/MRI/PET but not confirmed using ultrasound alone. For example, image fusion is often the optimal choice in the case of ablation of a tumor that can only be detected via MRI using Primovist as a contrast agent (EOB-only tumor). In cases when a tumor or part of a tumor still survives after repeated treatment, the tumor or residual parts may be very difficult to correctly locate using conventional ultrasound alone.[1,2] Less commonly, other uses of image fusion include treatment of tumors along the hepatic margin, where virtual CT images can be used to understand the characteristics of nearby organs, thereby ensure safer ablation. In the case of large, irregularly-shaped tumors, image fusion can facilitate the placement of needles in multineedle ablation. Furthermore, in conjunction with contrast agents, ultrasound on ultrasound image fusion technology can match the location and scope of ablation with preoperative ultrasound images acquired using a

Figure 1: A doctor performing radiofrequency ablation for liver tumor under fusion-image guidance

contrast agent and showing tumor size, allowing the doctors to determine whether ablation will have a sufficient safe margin. Greater familiarity with fusion-image technology will allow an even broader range of applications.

A learning process is required to use image fusion. The greater the operator's experience, the shorter the operating time and the greater the accuracy. As they advance, image fusion devices are also becoming more user-friendly, further shortening the learning curve. Recent autoregistration designs have made image fusion technology as convenient and handy to use as a smart phone.[3,4] Future developments virtually guarantee that manufacturers' future designs will be even easier to use.

When selecting ultrasound instruments with image fusion functions, despite the specific advantages of certain models, the differences between devices will be significant only in the case of patients with particularly difficult conditions. Since it is

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necessary to view B-mode images for all patients, the clarity of ultrasound images is the foremost consideration when selecting a machine. In particular, patients who have received repeated treatment for liver tumors can be very challenging patients for imaging diagnosis. Without clear images, no matter how accurate and convenient the positioning, the operator will find it difficult to perform ablation with confidence.

The author has used fusion-image technology for more than 10 years, routinely using it in all cases of liver tumor ablation. The technology can indeed overcome the problems described above, and can also provide additional information to help the operator. It will not only not increase ablation operating time, but also shorten the time needed to determine the correct focus. However, even when technologies such as image fusion, artificial ascites, and ultrasound contrast agents are employed together, mistargeting may still occur, or ablation may still not be feasible. As a consequence, operators must continue to learn with an open mind, must diligently and periodically review their operating skills, and must know their limitations if they are to achieve even better ablation results.

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