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Advances in Ultrasound: Smart Fusion Technology

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What Is Smart Fusion?

Smart Fusion presents volume-to-volume fusion of two different imaging modalities, using previously acquired images with real-time ultrasound. CT is the most commonly used modality for ultrasound fusion with the other option being MRI.

Toshiba's Smart Fusion is easier to use than previous fusion technologies. Originally, fusion required scanning the patient with CT, then performing fusion imaging while the patient was in the exact same position with ultrasound. This cumbersome method results in additional radiation exposure to the patient and occasionally additional contrast, along with the high costs of acquiring an ultrasound system and CT system together. But with Smart Fusion, previously acquired CT and MRI images can be imported onto the Aplio 500 ultrasound system. Smart Fusion has an easy-to-use, intuitive two-step user setup and is fully integrated on the ultrasound system.

Clinical Applications for Smart Fusion

In general, the clinical applications for Smart Fusion include three major components: diagnostic, interventional and therapeutic.

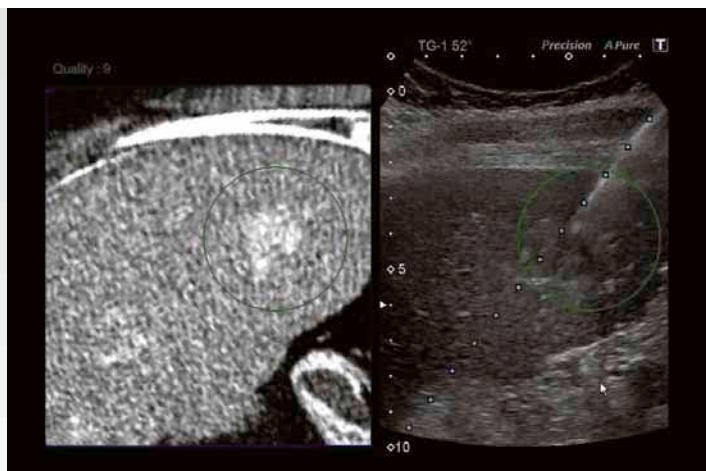
Diagnostic Applications

Ultrasound is extremely helpful in characterizing focal lesions as solid and/or cystic and plays an extremely critical role for patients who cannot receive intravenous contrast. MRI used to be the standard clinical practice for evaluating patients with impaired renal function, but the risk of Nephrogenic Systemic Fibrosis (NSF) has limited the use of MRI for these patients and expanded the use of ultrasound. Ultrasound is also a less expensive modality with no radiation exposure. However, one disadvantage of ultrasound is operator dependency. Operator skill is vital in obtaining diagnostic information using ultrasound. Smart Fusion minimizes this variability.

Smart Fusion can evaluate multiple focal lesions within a solid organ and visualize a specific lesion. For example, if a patient presents with multiple lesions, some being cystic and others solid, the operator can navigate through all the lesions individually and visualize and define each lesion and its proximity to any critical structures. Overall, Smart Fusion dramatically improves the accuracy of ultrasound in visualizing and identifying multiple focal lesions in an organ and improves the confidence of non-experienced operators.

Smart Fusion can also help track a lesion's change in size during follow-up exams. These small changes in size are usually difficult to notice with regular ultrasound. Smart Fusion will enable the operator to evaluate any questionable lesions in real-time to obtain more accurate diagnostic information.

Today's leading radiology departments rely on fusion imaging for better clinical accuracy. A new fusion technology, Smart Fusion on Toshiba's flagship Aplio 500 ultrasound system, merges previously acquired diagnostic images with real-time ultrasound to provide safer, faster exams with better diagnostic accuracy.



Interventional Applications

Smart Fusion improves interventional applications by reducing procedure times and providing a more comfortable patient experience. From a technical point-of-view, Smart Fusion enables different access points and orientations to be used, that cannot normally be obtained with CT. It has the ability to predict the location of the bowel, colon and biopsy lesions that may not be seen well with ultrasound alone. Smart Fusion also minimizes misinterpretation of ultrasound artifacts, which is a major limiting

factor when it comes to inexperienced operators, and decreases the number of non-diagnostic procedures.

When performing biopsies, some lesions are questionably visualized or not visualized at all on ultrasound. Smart Fusion enables the operator to conduct biopsies with ease and confidence. In the case of multiple lesions in a solid organ, the lesion of interest can be targeted more accurately using fusion than compared with ultrasound alone.

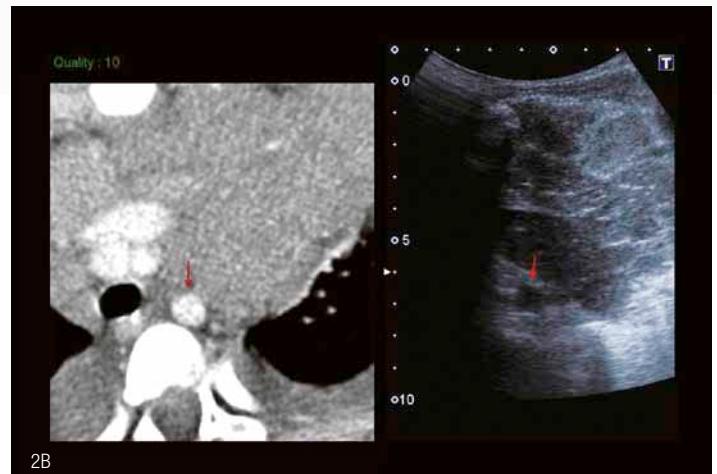
Any critical structure that is difficult to see on ultrasound, like bone, lungs or the colon can be clearly identified with Smart Fusion as the previously acquired CT or MR images follow the ultrasound transducer, improving patient safety and decreasing complications.

Therapeutic Applications

Imaging-guided therapy plays an important role in any radiology department offering minimally invasive procedures like abscess drainages, placement of



Figs. 1: This is a 40-year-old male with a possible liver lesion as marked by the black arrow. The lesion is identified on the CT image (Fig. 1A), but there was still a question if it was a true lesion. Follow up ultrasound shows no sonographic evidence of the lesion that appeared on CT (Fig. 1B). Another follow up ultrasound using Smart Fusion shows sonographic evidence of the lesion that appeared on CT. Further evaluation with a biopsy determined it was fatty changes. This case shows the dramatic value of Smart Fusion to more accurately visualize questionable lesions (Fig. 1C).



Figs. 2: This is a case of a 9-year-old male who presents with a large mediastinal mass seen on a prior chest CT (Fig. 2A). The mass appears to be encasing critical areas of the chest like the heart. By using Smart Fusion in the operating room, while the child is under anesthesia, the critical structures including the aortic arch are easily identified on the fused images. Additional fused images clearly visualize the descending thoracic aorta (marked by the red arrow in the image) (Fig. 2B) which can be difficult to visualize with ultrasound.

different catheters and shunts, placement of fiducial markers and tumor ablation.

One aspect of therapy-related treatment is abscess drainage. Typically, ultrasound is used in draining superficial abscesses, abscesses in solid organs or abscesses in the pelvis using transvaginal or transrectal drainages. Ultrasound has limitations in the abdomen, as it has difficulty imaging around the bowel. Smart Fusion eliminates this problem and will expand the utility of ultrasound

for deep abdominal abscesses as well as lesions that are usually difficult to approach with ultrasound alone.

Tips for Using Smart Fusion Effectively

Initiating Smart Fusion is operator-based and needs to be done appropriately as misalignment will potentially result in an undesired outcome. After the fusion is achieved, operators should reevaluate by using different target points to ensure accuracy of the fused images before

intervention is started. For example, in the liver, the transducer should be moved around to ensure that all the vessels are appropriately matched on both imaging modalities as well as the gall bladder. Scans obtained recently should be used to minimize potential changes in the patient body. Also previously acquired images should not be used if there have been interval treatments that might affect organ alignment. Another critical step is to screen the patient for implanted devices. Finally, the fusion sensor on the unit needs to be



Fig. 3: This is a case of an 80-year-old female with ovarian and colon cancer who presents with a large pelvic mass. The mass is easily accessible using ultrasound guidance, but there is always concern for interposing bowel injury. Using Smart Fusion, the target was selected, the cystic portion of the mass was easily avoided, the bowel is clearly visualized and the bowel motion can be confirmed using real-time ultrasound assessment.

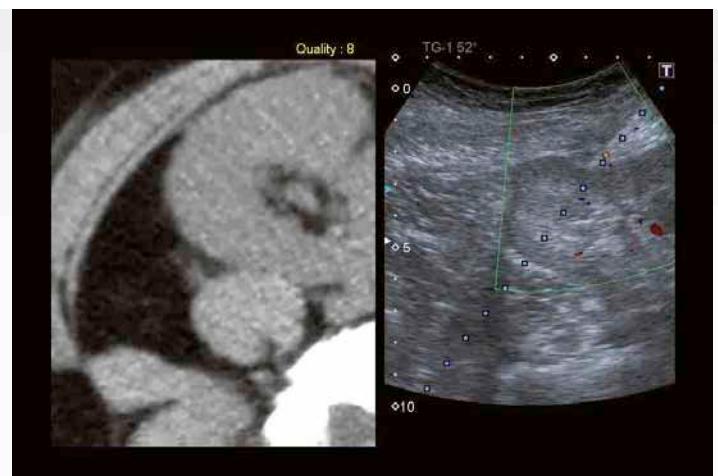
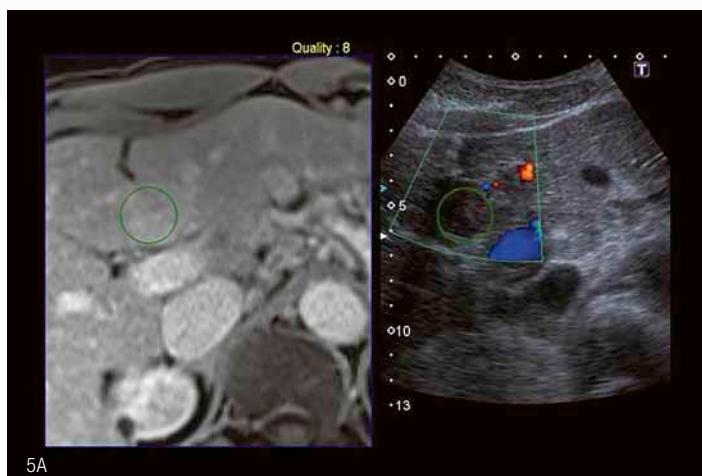


Fig. 4: A 35-year-old female with a renal transplant presents with worsening renal function and possible organ rejection. Previously acquired CT imaging is used for fusion, as avoiding the bowel is critical for this ultrasound guided biopsy. The bowel is clearly defined enabling safer intervention by avoiding damage to the bowel.



5A

Figs. 5: Here, a 30-year-old male with a history of hepatitis C presents with an enlarging hepatic lesion shown on MRI near the gallbladder. The lesion is atypical for a carcinoma. A previous biopsy revealed an area of fibrosis (Fig. 5A), but the increase in size is indication for biopsy. Smart Fusion clearly visualizes the gallbladder to improve safety during the intervention (Fig. 5B).



5B

close to the transducer. This can be achieved by changing the position of the patient, but after fusion has been achieved – the unit and the patient should not be moved to avoid misalignment.

A long way from the early days of matching functional ventilation-perfusion scans with chest X-rays,

Toshiba's Smart Fusion is extremely valuable in numerous clinical applications and expands the use of ultrasound. By increasing ultrasound applications, patient safety is improved by lowering the use of radiation emitting modalities. It also is more cost effective than other imaging types and reduces healthcare costs for many common interventional

procedures. As healthcare strives to be more efficient, integrating diagnostic procedures with Smart Fusion improves patient care and safety with more effective use of imaging.

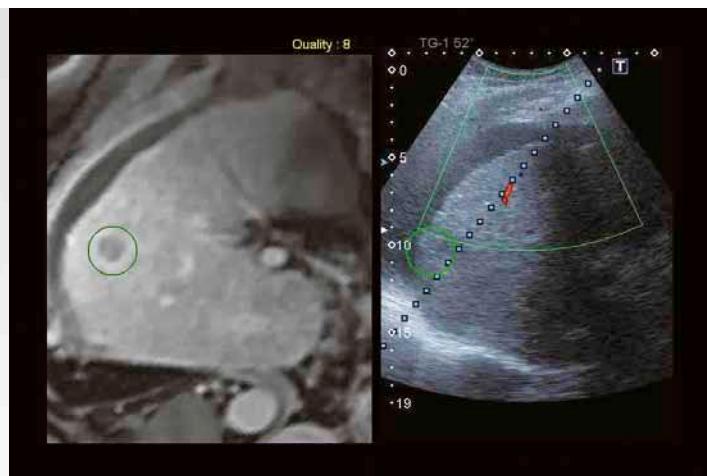


Fig. 6: A 55-year-old male with hepatitis B and liver cirrhosis presents with multiple lesions. On MRI imaging, the lesion is suspicious for malignancy, however this is atypical for this patient set. The lesion is poorly defined on ultrasound, but by using Smart Fusion the lesion is fully visualized and subsequent biopsy reveals hepatic carcinoma in the liver.



Fig. 7: A 55-year-old male referred with a pelvic mass biopsy, seen on a prior CT scan with no signs of fever or infection. Smart Fusion was used to avoid the bowel and hypogastric artery during the procedure.

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