GSI Xtream Delivers Simplified Workflow, Fast Scanning with High Image Quality and Dose Neutral Exams

When GE Healthcare developed its next generation Gemstone™ Spectral Imaging (GSI) solution, GSI Xtream, and introduced it on Revolution™ CT, the goal was to further improve small lesion detection, tissue characterization and metal artifact reduction with a simplified workflow that would seamlessly fit into daily practice.

GSI Xtream delivers 8 cm of coverage with ultrafast kV switching for spectral CT images. With ASiR-V™ and Gemstone Clarity detector, dose-neutral exams on any patient size are possible.[1] Material density and monochromatic images go beyond visualizing anatomy to characterizing tissues, which allows clinicians to better differentiate lesions with minor differences in contrast enhancement. And GSI MAR reduces the challenge of scanning a patient with metal artifacts while keeping spatial resolution, so clinicians can visualize surrounding anatomy.

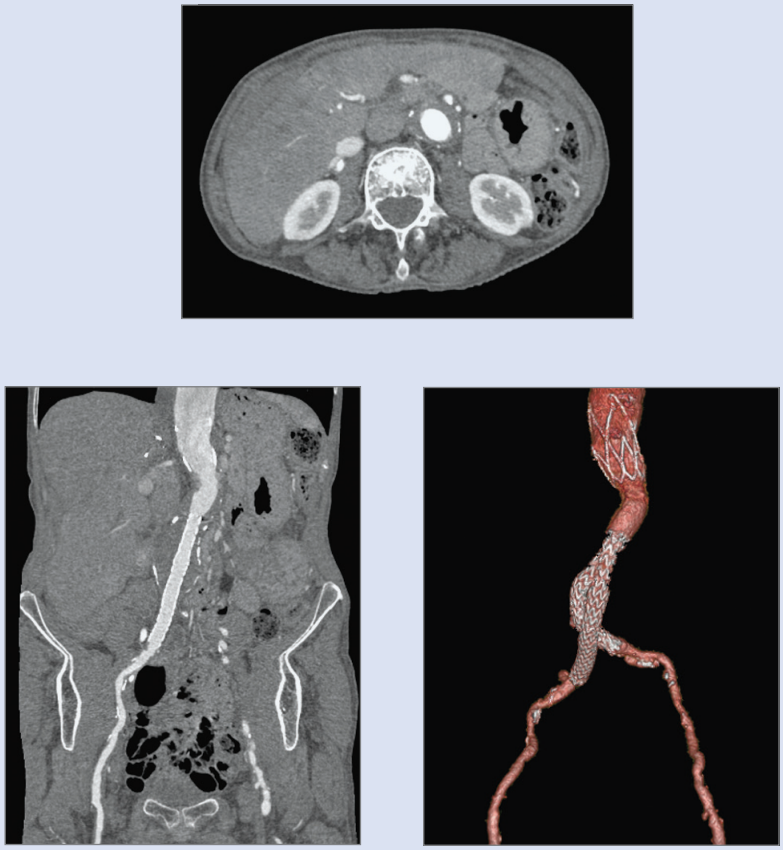

Figure 1. Patient with abdominal aortic aneurysm evaluated after placement of bifurcated stent graft. No endoleak or extravasation of contrast detected. Parameters: 80 mm helical GSI Xtream, dual phase, 0.992:1 pitch, 0.6 sec rotation, 355 mm coverage, 35 ml IV contrast. Dose: CTDI 5.58.

Images courtesy of Froedtert Hospital.

In addition to improvements in lesion detection and characterization, simplifying clinical workflow was also addressed. GSI Xtream is as intuitive as a single energy exam. GSI Assist and Clinical ID help standardize and automate protocol choice with images directly transferred to PACS and/or AW. These improvements, combined with native GSI reconstruction, deliver spectral CT workflow that is twice as fast.[2]

Two early adopters of GSI Xtream on Revolution CT, CHU Henri Mondor in Creteil, France, and Froedtert Hospital in Wauwatosa, WI, share their initial workflow and clinical experience with *Clarity*.

Workflow

Bret Barnes, RT(R), CT Imaging Specialist at Froedtert Hospital, has been scanning patients with earlier versions of GSI and now GSI Xtream.

Froedtert utilizes an electronic protocoling process that radiologists can use to request spectral imaging for a patient study. Between 40-50% of patients at Froedtert are now scanned with GSI, either on the Discovery™ CT750 HD or Revolution CT. With two scanners, the hospital can meet 90% of all requests for spectral imaging, a vast improvement in patient care.

"I'm able to provide the radiologist and the referring physicians with additional information that can help them make a confident diagnosis," Barnes says. "With the GSI images, it is much easier for them to identify if there are lesions or disease."

On prior versions of GSI, a long acquisition such as a vascular runoff study would require the CT scanner to be on standby while the reconstructions were processed on the CT console.

"With the speed of GSI Xtream, we can run patients back-to-back without the need to first let the reconstruction process finish," Barnes said. "If we could perform all of our spectral imaging on Revolution CT we would because the image quality, speed and throughput is better than on our other scanner," Barnes adds.

However, with the other strengths of this system, such as 160 mm detector coverage and exceptional capabilities of Revolution CT in cardiac imaging, nearly all gated studies are performed on it, limiting available imaging slots.

One of the most significant image quality enhancements he has seen are in material basis pairs. Previously, these images had a "mottled appearance" that is much less apparent on GSI Xtream. Yet, it is the system speed of Revolution CT that has made the most significant impact in Barnes' day-to-day workflow.

"The speed of the acquisition in spectral imaging is two-times as fast as the prior system," he adds. "Patients hold their breath half as long as before, and that is really key when imaging larger patients for a longer distance without the tube heating up." He can acquire up to 245 mm/sec with HyperDrive and GSI Xtream.

HyperDrive is used in single energy scanning and further enables fast acquisitions with a table speed of 437 mm/sec at the full 50 cm FOV. This capability is particularly important for patients who cannot hold their breath, in trauma patients who need a rapid diagnosis and in pediatrics.

Another workflow improvement is the ability to reconstruct one specific region of the patient's anatomy. For example, in a chest-abdomen-pelvis exam, if the radiologist wanted the lungs reconstructed differently, the prior version of GSI required the entire study be reconstructed in that same manner—it was all or nothing. This further impeded workflow. Now, Barnes can select just that region, the lungs for example, and reconstruct it without tying up the scanner to reconstruct the entire study.

Barnes uses GSI Assist to further refine the GSI acquisition profile to meet certain clinical needs, such as a request for high temporal resolution or low contrast detectability.

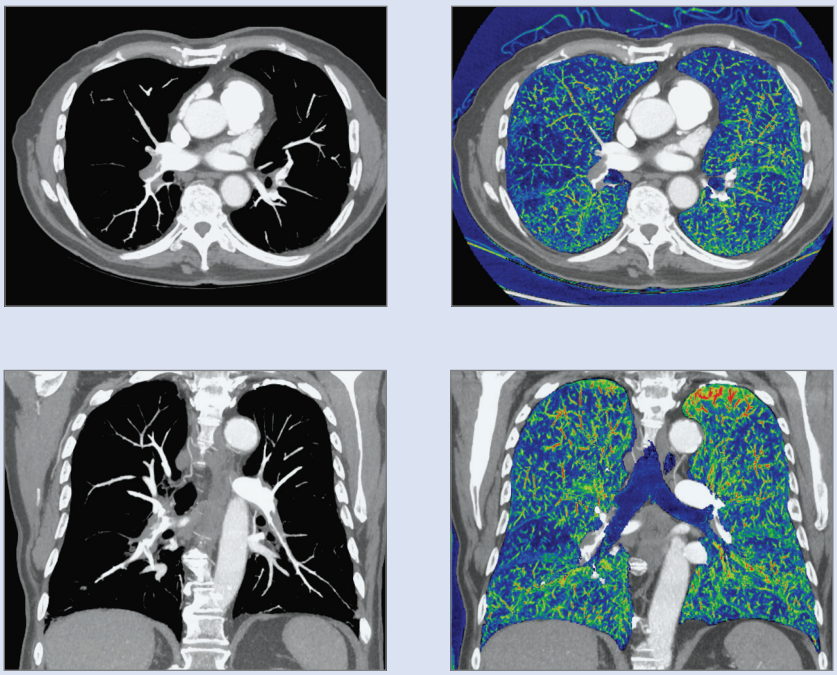

Figure 2. Patient with shortness of breath with positive D-dimer. Diagnosis: Prominent bilateral acute pulmonary emboli with extension into the lobar branches of each lung. Parameters: 80 mm Helical GSI Xtream, 1.531:1 pitch, 0.5 sec rotation, 300 mm coverage. Dose: CTDI 8.67.

Images courtesy of Froedtert Hospital.

These capabilities are pre-programmed into the system protocols so he does not have to modify on-the-fly. It also helps simplify the technologists' workflow as they can isolate those protocols that meet the specific clinical need. For example, if he wants to use a fast acquisition with HyperDrive, GSI Assist presents him only with the protocols that match the request.

Less contrast administration and excellent image quality

For W. Dennis Foley, MD, FACR, Professor of Radiology at the Medical College of Wisconsin and a radiologist at Froedtert Hospital, the increase in image quality with Revolution CT translates to lower volumes of contrast for patients undergoing vascular imaging. Patients can be scanned more quickly with the wide detector coverage, which also offers uniformity in the image.

"Low contrast administration is important for patients with renal insufficiency," Dr. Foley says. "For abdominal studies of the liver, pancreas and kidney, we can accentuate the image contrast with monochromatic and material specific imaging using GSI Xtream."

According to Dr. Foley, the monochromatic images allow for the detection of small hepatic, pancreatic or renal lesions that may be missed on systems with inferior contrast resolution.

Spectral imaging is also useful for detecting pulmonary embolisms (PE), particularly subsegmental PE in the small pulmonary branches. Dr. Foley can also more confidently determine the chemical composition of a renal stone—whether it is a urate or non-urate calculus—to best guide patient management.

"The one major overall benefit that everyone in our department is remarking about is the excellent image quality," Dr. Foley says. As important, the image quality has increased with the same dose levels as a single energy exam—all spectral CT exams performed at Froedtert Hospital are protocolled to be dose neutral.

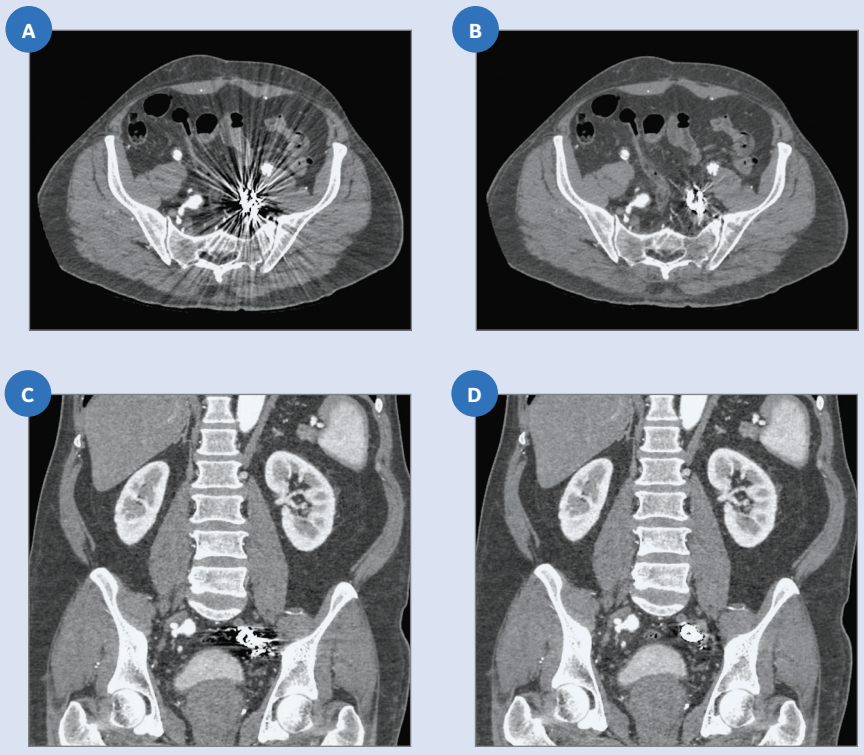

Figure 3. Follow-up postoperative aortoiliac surgical graft and coil. (B, D) Note the improved image quality with MAR. Parameters: 80 mm helical GSI Xtream, 0.992:1 pitch, 1.0 sec rotation, 530 mm coverage, MAR mode to reduce artifact. Dose: CTDI 27.51.

Images courtesy of Froedtert Hospital.

Metal artifact reduction with GSI MAR is also helpful in patients who have implants. Dr. Foley explains that if a patient has a lumbar spine implant, the artifact can overlay the aorta making diagnosis difficult. With GSI MAR suppressing the artifact, he is presented with more imaging information to make the diagnosis.

One area that Dr. Foley intends to explore in clinical research is the diagnostic utility of monochromatic and material specific images in a wide range of clinical applications. He finds a concordance in the information between the monochromatic images, which show the full range of tissue contrast, with material density images that improve contrast in vessels and small tumors.

Lesion detection

Professor Alain Luciani, MD, a radiologist at CHU Henri Mondor in Creteil, France, uses GSI Xtream on Revolution CT for improved lesion detection and characterization in liver oncology. "It's something to catch tumors that you would have missed," he says. "I'm not saying we can detect more tumors, I'm just saying it's much easier to detect the enhancing portion of the tumors."

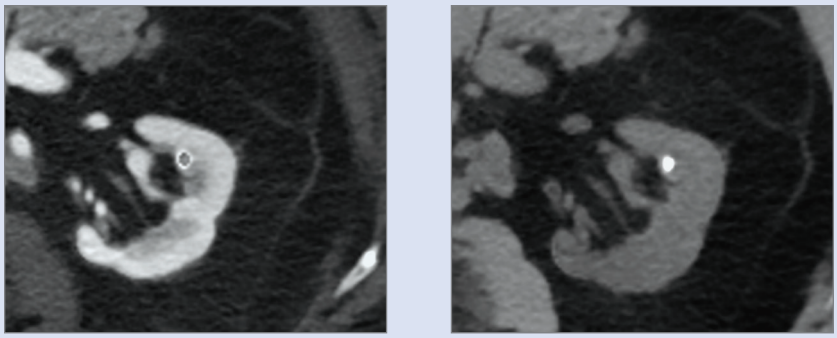

Figure 4. Woman with ovarian cancer post hysterectomy. Diagnosis: Lymphadenopathy and non-obstructing 0.5 cm left renal calculus. Parameters: 80 mm helical GSI Xtream, C/A/P, 0.992:1 pitch, 1.0 sec rotation, 530 mm coverage. Dose: CTDI 37.44.

Images courtesy of Froedtert Hospital.

What's more, he says spectral imaging can help with quantitative analysis of liver tumors. "You can actually separate different components of tumors with spectral imaging," he says. "You can see the highest peak of iodine concentration and how that behaves differently from the total tumor. And of course, that behaves differently from the liver. So that can provide tools to separate different components of the tumors, which is the first step to quantitative analysis of different portions of the tumor."

He recalls a melanoma study performed in 75 patients where there was an improved rate of metastases detection with spectral data versus polychromatic standard data.[3] "The authors concluded that more lesions were detected in those patients [scanned with dual-energy CT], especially metastatic lesions located in the muscles or in soft tissues."

Various literature studies have already tested the role of dual-energy CT (DECT) in oncology patients. A Danish team reported a nicely designed ex vivo and in vivo study of lymph nodes within the mesorectum in patients with rectal cancer. A total of 240 lymph nodes were assessed on dual-energy CT.[4] "Spectral CT increased contrast within enhancing lymph nodes close to the rectal tumors and provided accurate staging similar to MRI," Professor Luciani says.

With the combination of ASiR-V[1] and the Gemstone Clarity detector, he can lower patient radiation dose, leading to newly designed acquisition protocols benefiting from the improved contrast-to-noise ratio obtained on GSI, allowing lower dose acquisition parameters. For example, Professor Luciani imaged a patient from the chest to the pelvis in a single polar venous phase acquisition on spectral CT with a CT dose index of 8 mGy—much lower than the previous CT dose index of 14 mGy without the GSI acquisition. "The challenge now must be to pursue these optimizations in order to reach a neutral dose when comparing GSI to a non GSI technique."

Overall, Professor Luciani has found that GSI Xtream on Revolution CT delivers improved algorithms, less noise and better virtual unenhanced views than the prior generation of GSI. In general, he is a strong believer in the added clinical value of spectral imaging.

"Spectral CT is a tool for optimal tissue characterization in terms of acquisition, instrumentation, workflow and reconstructions. It also has a potential role in quantitative functional imaging," says Professor Luciani. ■

References

1. In clinical practice, the use of ASiR-V may reduce CT patient dose depending on the clinical task, patient size, anatomical location and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.
2. Compared to the prior generation GSI on Revolution HD.
3. Uhrig M, Simons D, Bonekamp D, Schlemmer HP. Improved detection of melanoma metasteses by iodine maps from dual energy CT. Eur J Radiol. 2017 May; 90:27-33.
4. Al-Najami I, Lahaye MJ, Beets-Tan RGH, Baatrup G. Dual-energy CT can detect malignant lymph nodes in rectal cancer. Eur J Radiol. 2017 May; 90:81-88.

To learn more on how these two hospitals are using Revolution CT with GSI Xtream, please visit the GSI Education Center at www.gehealthcare.com.