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World-Leading Myeloma Institute Relies on PET VCAR and Q.Clear to Track Disease Progression

As one of the leading centers in the world for research and clinical care of multiple myeloma and related diseases, the University of Arkansas for Medical Sciences (UAMS) Myeloma Institute has helped pioneer many of the advancements that have become standard of care. A central tenet of this research and clinical practice is the increased significance of innovative medical imaging devices, such as the Discovery™ IQ PET/CT system.

"PET/CT is important not only for traditional purposes such as staging and restaging cancer, but also to identify lesions that are appropriate for histologic and genetic sampling," explains James E. McDonald, MD, FACR, Associate Professor and Chair, Department of Radiology, and Director of the Division of Nuclear Medicine and Imaging Service Line at UAMS. As an example, Dr. McDonald cites a recently published paper by UAMS clinicians that reports the assessment of total lesion glycolysis (TLG) and metabolic tumor volume (MTV) by ^{18}F-FDG PET/CT significantly improves the prognostic value of gene expression risk assessment and the international staging system in myeloma patients.[1]

"We demonstrated that total lesion glycolysis can provide a more accurate prognosis than any of the other usually applied parameters," Dr. McDonald continues. "And that makes sense, because it combines the number of lesions, intensity of the hottest lesions, tumor volume and intensity of the uptake in the tumor."

Conducting this analysis was time consuming and laborious. In fact, a researcher spent a summer drawing regions of interest and adding up the data. "PET VCAR will make that process much easier and can reduce a process that can take an hour or more down to a few minutes," he adds. "From what we've seen in commercially available solutions, PET VCAR is the most powerful software for managing linear PET/CT datasets, such as designating and characterizing lesions and propagating that information forward to the next exam to track patient response."

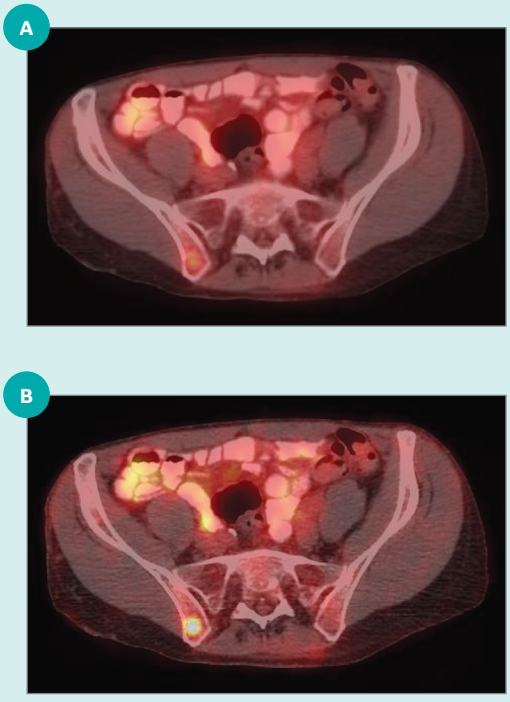

Figure 1. A focal lesion in the pelvis not visible on (A) attenuation-corrected image can be seen on (B) the Q.Clear reconstructed image. Confirmed by WB-DWI (MRI). This is an excellent example where the imaging information obtained from Q.Clear changed the management of a patient with small lesions.

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Small lesion detectability

In addition to PET VCAR, another key reason the Myeloma Institute was interested in the Discovery IQ 5-Ring PET/CT system was its industry-leading sensitivity, up to 22 cps/kBq,[2] and highest clinical Noise-Equivalent-Count-Rate (NECR) for clinical ^{18}F acquisition,[3] which allows the flexibility to lower dose or perform faster scans—or a combination of both. Dr. McDonald was also intrigued by Q.Clear, GE's pioneering full-convergence reconstruction technology that provides up to 2x improvement in both PET quantitation accuracy (SUV_{mean}) and image quality (SNR).

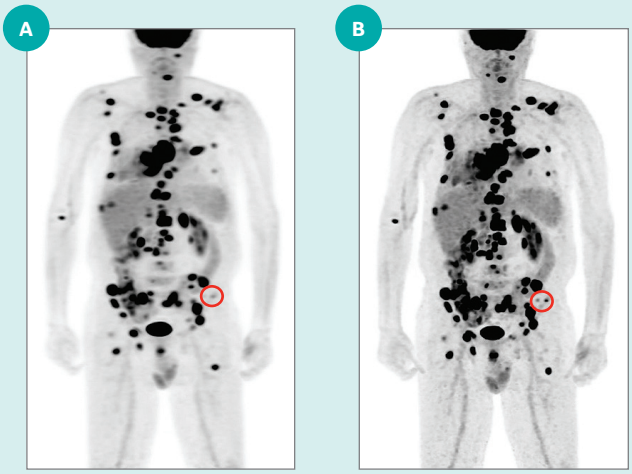

Figure 2. (A) Standard reconstructed versus (B) Q.Clear reconstructed images.

All myeloma patients receive a PET study and an MRI whole-body diffusion weighted imaging (WB-DWI) study. According to Dr. McDonald, UAMS began using WB-DWI in 2011 and learned that it was more sensitive than PET for small lesions. However, since they began using Q.Clear on Discovery IQ, that perception has started to change.

"There is a theoretical limit with PET, but Q.Clear is clearly getting there," says Dr. McDonald. "We are finding with the combination of higher sensitivity and Q.Clear, it more closely approximates DWI."

It is possible for a clinician to miss a small, subtle lesion on a standard PET reconstructed image, he adds. However, his diagnostic confidence with Q.Clear is much higher than when using standard reconstructions.

"When I read a case, if it is negative on Q.Clear then I'm more confident that it is truly negative," says Dr. McDonald. "If I see a small lesion on Q.Clear, I can go back to the standard reconstruction to see if it was missed. I am sure that Q.Clear is more sensitive and also probably more specific with the system's increased resolution."

Published studies from UAMS and other institutions have shown that patients with lesions having an SUV greater than 3 have a poorer prognosis. Dr. McDonald explains that Q.Clear's Q.SUV will be higher, therefore hotter; however, in myeloma cases, the small lesions are hotter on Q.Clear than on standard reconstruction. Also, phantom studies conducted in the department have demonstrated that Q.Clear more closely approaches that "true" number in the phantom—the more iterations, i.e., full convergence, the more accurate the number, Dr. McDonald adds.

"I know Q.Clear is better because I can see lesions better," he says. "Everyone wants to know how much better, and it's too early to say. We are planning a study to establish the value, but the only way to do that is to look at outcomes."

Dr. McDonald is interested in examining how higher sensitivity and a more "true" SUV translates to patient outcomes; however, a study of this nature will require years of data collection. For now, the department is focused on reporting the exam results with both Q.Clear and the standard reconstruction while gathering the data for a retrospective review study.

More scans, less dose

Prior to installing Discovery IQ, the department had two 10-year-old PET/CT systems. On average, the department would perform 30 PET scans each day, with half being whole-body myeloma studies that historically took one hour to complete.

Now at UAMS, with Discovery IQ each whole-body myeloma exam lasts approximately 15 minutes—or 75% less time.

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This translates to more people being scanned—about 2-3 more patients per hour or up to 25 patients each day... nearly the same volume as the two prior systems.

Perhaps more important, patient dose has also been reduced. Dr. McDonald explains that many myeloma patients receive multiple scans over the course of their lifetimes: for staging, post-treatment and often yearly scans for those in remission or considered cured. With Discovery IQ, UAMS has decreased injected dose by one-third from 15 mCi to 10 mCi for PET scans. With iterative reconstruction on the system's CT scanner, the dose is also one-third less than on the previous scanners.

Yet, it is the system speed that patients and technologists most often comment on. "Speed and throughput is a significant factor for the patient experience," Dr. McDonald says. "Our patients have had these exams conducted before, and no one wants to stay in a PET/CT scanner longer than they have to."

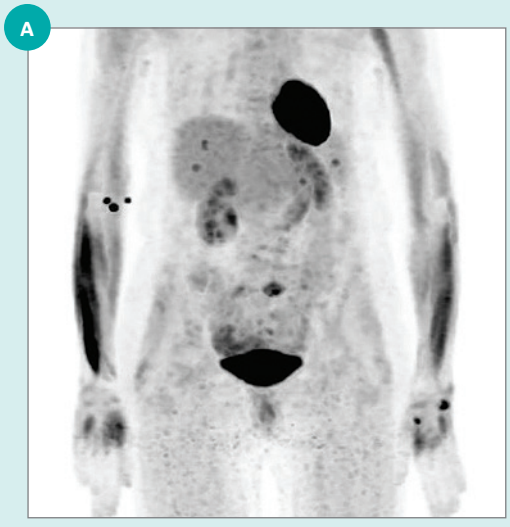

Figure 3. The improvement in image quality that Q.Clear provides, along with the high sensitivity of the Discovery IQ PET/CT, assists the clinician in detecting small lesions that may otherwise be missed.

Following disease progression

Staging of myeloma in a patient remains highly dependent on the lab values. However, PET/CT is an integral tool for monitoring disease progression and re-evaluating the patient's disease stage. Myeloma is a disease that develops through a number of clinical stages, Dr. McDonald explains.

Patients with monoclonal gammopathy of unknown significance (MGUS) have plasma cells that are pre-malignant. MGUS occurs in approximately 1.5% of the general population and in 3% of healthy people 70 years or older. Since the disease is benign it requires no treatment. However, each year 1-2% of people with MGUS will progress to multiple myeloma.[4]

While clinicians can follow serum protein levels and other lab results, "Imaging is the most definitive method we have to tell when that transition from benign to malignant happens," says Dr. McDonald. The sooner this transition is recognized, the earlier the patient can begin a more aggressive therapy. With Q.Clear, Dr. McDonald says they are now on the threshold of having this capability, as Q.Clear is more sensitive in helping with the detection of these smaller, initially malignant lesions. Further, if PET shows a response to therapy compared to the baseline, then the patient has a very good prognosis. If the lesions remain metabolically active, the treatment regimen is modified; however, the patient has a poorer prognosis. Dr. McDonald and his colleagues at the Myeloma Institute, including Faith Davies, MD, Leo Rasche, MD, PhD, and Gareth Morgan, MD, PhD, have submitted a paper to a peer-reviewed journal that he says, "proves what we've always been saying...whether or not the lesions respond to therapy on a follow-up PET can determine the patient's prognosis and outcome." ■

References

1. McDonald JE, Kessler MM, Gardner MW, et al. Assessment of Total Lesion Glycolysis by ^{18}F FDG PET/CT Significantly Improves Prognostic Value of GEP and ISS in Myeloma. Clin Cancer Res, April 15 2017; (23)(8):1981-1987.
2. 22 cps/KBq represents typical system performance for a 5-Ring system, measured according to NEMA Standards Publication NU2-2012.
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4. Multiple Myeloma Research Foundation. Monoclonal Gammopathy of Undetermined Significance (MGUS). Available at: https://www.themmrf.org/multiple-myeloma/classifying-multiple-myeloma/mgus/. Accessed on April 24, 2017.