Challenges in Imaging Obese Patients

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By Deborah Abrams Kaplan [7]

When it comes to working with obese patients, manufacturers and clinicians are trying to solve the challenges presented in diagnostic imaging.

As obesity rates continue to rise in the United States, radiologists and technologists face challenges imaging larger patients, despite the effort of manufacturers making machines better able to accommodate them. What are these challenges and what is the industry doing to help?

If current trends continue, 44 percent of U.S. adults will be obese within 20 years, with rates exceeding 60 percent in 13 states.
For geographic areas with less of an obesity problem, the solution is usually solved by purchasing machines that can accommodate 450-500 pounds, Raul Uppot, MD, interventional radiologist at Massachusetts General Hospital and assistant professor at Harvard Medical School told Diagnostic Imaging. “But even if you have trouble getting one person on the machine, this is a problem,” he said.

The Reality
Statistics are one thing, but for radiological technologists like Curtis Carpenter in Vero Beach, Fla., the problem seems to be growing. “It’s a major problem not only for seasoned technologists, but for students coming out of school who don’t know what to do when they have someone who is so large,” he said.
Carpenter’s current employer just purchased a new lithography machine because the previous one wasn’t robust enough. “We kept canceling patients because they exceeded the 300 pound weight limit,” Carpenter said. “We had to make a $650,000 expenditure because of the obesity problem.”
It’s an issue for everyone involved in imaging, said Uppot. As the front-line people moving the patients onto the scanner tables or turning over patients during an ultrasound, technologists have to worry about injury. Newer equipment with pulleys help do this more safely.

MRI scanners tend to have a lower weight limit and smaller gantry, while CT machines are slightly larger. “The most common point at which hospitals get into an issue, is when the patient can’t fit into the CT scanner,” Uppot said. Some outpatient open MRI units can support a slightly larger weight limit. And ultrasounds can be used if the patient isn’t mobile, but due to tissue amount, you can’t always get a good image.
When this happens, you revert to pre-imaging days, relying on a physical and clinical exam, said Uppot, to help determine the diagnosis. “With imaging, we’ve been spoiled. They come in, and we scan them for an answer,” he said. “If imaging equipment isn’t available, you have to revert back to your clinical skills.” It might result in the patient getting exploratory surgery, which is already more difficult on bariatric patients. If the patient is stable, Uppot said, they’d be observed after a clinical exam and treated empirically.

Manufacturing Challenges
While making larger machines is a business opportunity, it’s also a challenge. And they’re not just creating these machines to handle obese patients, but also to accommodate those who are tall, athletic or pregnant, all of whom can be difficult to image said Michael Wendt, senior vice president of the imaging and therapy systems division at Siemens Healthcare in the U.S. and Canada. “We’re not singling out or making products purely for obese patients, but a wider population,” he said.
The most limiting part of the anatomy isn’t fat, but the shoulders, said Lawrence Murphy, chief designer at GE Healthcare. A 65–70 cm bore often restricts the shoulders more than a large abdomen. When people lie down, they puddle, meaning their body relaxes and tissue spreads out, helping them fit into the machine, said Murphy. However, large and athletic people have large shoulders, making it difficult to fit them into the bore.
Newer imaging machine design specifications include several categories, Wendt said, including table weight capacity, gantry size and image quality/patient safety. While increasing table weight capability, the machine must still be able to lift, tilt and advance accurately. Patients have to fit in the gantry. And image quality must be sufficient and uniform enough for diagnostic-quality images,
without increasing the radiation dose to unsafe levels. Yet there are physics issues that limit the machine size, said Bob Schwartz, general manager of global design and user experience for GE Healthcare. Even open MRI systems, which are touted as a good solution for larger patients, have a trade-off in terms of image quality, he said. These MRI machines accommodate larger patients because patients aren’t positioned in a tube, however the scanning time is significantly longer, said Murphy. The difference might be a 45–60 minute scan in an open MRI, versus a 20 minute scan in a traditional machine.

**X-ray**
The first time you see a patient for an X-ray image, Carpenter said, you have to figure out your approach. For example, for a 6’1, 380-pound patient, you question whether he should lie on the table or stand. You consider his mobility and other parameters. “All this is cycling through your head when you’re introducing yourself,” he said.

He manipulates his parameters for patients over 220 pounds. “That’s not a number you’d read in a book, but with anything over that, we start seeing diagnostic quality issues with the imaging. We start having to use a lot more radiation to obtain the image.” While patients are getting larger, X-ray physics haven’t changed. “We use the same X-ray principles we’ve used for 120 years.”

**MRI**
MRI scanner bore sizes have been increasing in recent years, from 60 to 70 cm, said Wendt. That’s helpful for patients with claustrophobia, but it enables many larger patients to undergo the examination. The demand for this larger bore technology is high, he said.

“The bigger opening of the patient bore is probably the biggest engineering challenge to overcome,” he said, because they have to integrate the MRI components into a tighter space. “The outer dimensions are the same size, [but] the gantry is 10 cm larger.” The challenge in increasing the radius, is encountering significantly higher mechanical forces. Other challenges are increasing the weight limit on the patient table, and writing new techniques to accommodate the larger imaging area. “The bigger the patient, the bigger the area for a constant or homogenous magnetic field. That is very challenging,” Wendt said.

In addition to changing the bore size, manufacturers like Siemens have also reduced the patient loading heights, so tables lower closer to the floor.

**CT**
When an obese person presents in the emergency department, the best imaging modality to use is usually the CT scanner, said Uppot. As long as they fit on the table and in the scanner, the protocol can be adjusted to get good image quality.

The first question a technologist will consider, said Carpenter, is if the table can hold the person’s weight. Even if it can, he needs to increase the splice thickness. He may scan the patient with a thicker slice, which decreases image quality. “If you’re looking for a kidney stone and scanning a big abdomen, you may miss the stone,” he said. “If the slice is 5 mm thick and the stone is 4 mm thick, the stone will go undiagnosed.” With a smaller slice of 1-2 mm, you’d be able to see the stone in several images.
and operations, computed tomography and radiation oncology business management at Siemens Healthcare. FAST CARE technology is Siemens' automated workflow for technologists, which also reduces radiation levels.

For example, a standard patient might be scanned at 120 kV, but a larger patient might need 140 or 150 kV. “It creates a more automated approach when selecting the technique,” Mochon said. “When you don’t have an automated approach, the technologist may not remember to change the kV to 140, so images may not be diagnostic.” Nondiagnostic images can lead to repeat scans. They offer this technology on their 78 cm bore SOMATOM Definition-class CT scanners, which accommodates patients up to 676 pounds.

**Ultrasound**

Ultrasound in obese patients can be quite challenging. “You need enough energy that can be transmitted to penetrate the patient,” said Wendt. The machine needs to penetrate additional tissue and fat before the ultrasound wave reaches its desired structure and travels back. One problem with using ultrasound on obese individuals is the attenuation, he said. “You need machines with enough energy and hardware and software techniques that will compensate for the imperfections introduced because of the other tissue.”

**Workarounds**

When a technologist is working with a patient who either doesn’t fit in the machine, or whose size makes imaging difficult, there are tricks of the trade to consider.

One radiology department fashioned a hula hoop the size of the CT scanner bore, said Uppot. It’s been useful for patients who match the table weight but may not fit into the machine’s bore. If the patient doesn’t fit in the hula hoop, they avoid the frustration of trying to get them into the gantry. Even if the image is acquired, Uppot said, the diagnosis might be too hard to make because the tissue might obscure the issue. Carpenter agreed. “Ideally you really don’t want to do anything substandard, but a lot of times your hands are tied and you do the best you can and hope you can get something out of the image the radiologist can use to get a diagnosis,” he said.

As a last chance, patients might be sent to a veterinary clinic, said Carpenter, who said he referred two patients in 10 years to vet offices for an X-ray. “You really don't want to go through that,” he said. “It’s embarrassing to the patient, and it’s awkward to explain to the vet office that you have a patient as big as a horse.”

“We sell our scanners to veterinary settings, with tables designed to handle horses, or two tons of weight, that can still bring you to the CT,” said Siemens executive Mochon. Imaging systems of this size aren’t practical in a typical healthcare environment, Mochon said, where space is at a premium. Hospitals are designing facilities, not just radiology suites, to handle patients up to 650 pounds, in a safe way, he said.

Most patients can be accommodated in some way, but there’s a diminished ability in using imaging techniques for the largest patients. “You have this problem and we’re not going to find out what it is because you’re overweight,” said Carpenter.

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