Sophisticated intraoperative imaging suites, with their special facility needs and high cost, are usually found in academic medical centers. But a community hospital in Wisconsin has installed an intraoperative MRI and is helping to support it by also using it as a diagnostic imaging facility.

The MRI equipment is located at one end of the operating room so it can be accessed by separate entrances. The MRI scanner, ceiling mounted on a motorized track, is separated from the rest of the room by sliding stainless steel doors, which are opened for surgery and closed for diagnostic use. The OR walls and doors are copper lined.

The sophisticated imaging system allows for large-scale data display.

“The OR walls serve as information billboards,” says Marshfield Clinic neurosurgeon Kamal Thapar, MD, describing the new advanced neurosurgical suite at 340-bed Sacred Heart Hospital in Eau Claire, Wisconsin.

Formerly an academic surgeon in Canada, he came to Sacred Heart 6 years ago to start a neurosurgery program that has had an effect on all of the specialties. Sacred Heart has 9 conventional ORs, the MRI OR, and will soon open a CT OR for spinal procedures. The hospital performs more than 600 spinal procedures annually.

The high-tech suite takes surgery to the next level, Dr Thapar says. A physician can access the applications, housed in the operating suite, from workstations in the clinic. The seamless data integration and transmission are particularly useful for imaging and preoperative planning, he notes.

“Some would call an intraoperative MRI scanner just another trendy piece of equipment. But it is not,” he says. “An MRI OR is an entirely different environment configured to try to make surgery as safe and effective as possible. We’ve found this view to be easy to justify to our board of directors.”

As director of the Brain & Spine Institute and director of tertiary care services at Sacred Heart Hospital, Dr Thapar was instrumental in setting up the suite, which integrates IMRIS’s intraoperative MRI magnet with BrainLab’s navigation and image-data management.

Leaps beyond

Intraoperative MRI is several leaps beyond fluoroscopy and intraoperative ultrasound. Fluoroscopy is 2-dimensional and provides limited information on whether an implant has been properly placed, he notes. Fluoroscopy cannot be used for soft tissue imaging. As a result, he says, surgeons and manufacturers have been looking for ways to bring the best of digital imaging technology into the OR, including intraoperative MRI and CT scanning, and integrating these with navigational guidance.
Preoperative MRI alone was not sufficient. “When I look at a brain tumor on an MRI scan, that tumor exists in a virtual-digital world. It doesn’t tell me where that tumor is in the patient’s head,” Dr Thapar notes. The old way was to make a large incision and explore the brain, which carries substantial morbidity.

The next advance was to take preop MRI imaging data into the OR and integrate it with a global positioning system, allowing the surgeon to know exactly where the tumor was and where to operate.

But this software-guided imaging still had limitations. During surgery, the data set can change as the brain shifts, and by the end of the procedure, the original imaging data is no longer accurate. Surgeons then asked: “Why can’t we configure an operating room with the same tools as a radiology suite?” That would provide real-time imaging, allowing surgeons to scan the brain both during and at the end of surgery to make sure they had completely removed a tumor.

“The most common question a patient’s family asks following removal of a brain tumor is, ‘Did you get it all?’” he says. “Now, with this technology, we can answer with certainty, because the procedure only concludes when we have radiologic confirmation that the tumor is entirely removed.”

**Changing the playing field**

Dr Thapar says his goal has been to take these powerful technologies and apply them to common procedures in community hospitals.

“Whereas MRI and CT were once diagnostic tools, we now regard them as therapeutic tools that guide the surgeon in the operating room,” he says. “We want to know how we can use this new technology to reduce the size of incisions, the length of stay, and postoperative pain and overall make surgery safer.”

He predicts surgeons will rely more and more on intraoperative imaging.

“Surgeons want to know that a pedicle screw is appropriately placed, and a tumor has been removed in its entirety while the patient is on the OR table, not the following day when postoperative imaging is performed.”

**Cost considerations**

Despite the power of the imaging, most hospitals don’t perform enough neurosurgery to justify the cost of an intraoperative MRI suite. The MRI OR suite at Sacred Heart, which includes the scanner plus an integrated navigation system and monitors, cost $6.4 million, including:

- room construction: $880,000
- equipment: $51,000
- MRI magnet: $3.1 million
- MRI navigational system: $2.3 million.

To provide a greater revenue stream, the MRI OR was built to be used both for surgical and diagnostic purposes without violating OR access restrictions.

“When we initially designed the MRI OR suite, we thought about how we were going to utilize the square footage and the MRI because there are only so many brain tumors you can resect,” says Loren Lortscher, RN, BSN, director of surgical services at Sacred Heart.

The motorized track, stainless steel doors, and positioning of the suite allows dual access to the adjacent intensive care suites so intraoperative MRI can be used for diagnostic purposes when it is not being used for surgery.

**CT OR is next**

Next for Sacred Heart Hospital will be a CT OR by BrainLab, which is under construction and expected to open in 2009.

The intraoperative CT scanner is less expensive than an MRI, at about $1 million. The configuration of the CT OR is not only less expensive than the MRI OR, but it will be used daily for spinal and ENT surgeries. The CT scanner will also be on rails so surgeons can roll it up to the patient, take the scan, and roll it back. The CT scanner will be permanently placed in the room, but unlike the MRI scanner will not be used diagnostically.
Dedicated team

A dedicated neurosurgical team composed of 4 RNs and 4 surgical technologists was created to work with these new technologies. Dr Thapar says a dedicated team is essential. The technology alone without the needed skills would keep the technology from providing a return on investment.

The neuro team has had a “dramatic impact” on reducing the length of surgical procedures, he says, with the average procedure time reduced by 20% since the team was launched. This has been true regardless of the complexity of the surgery or the neurosurgeon performing the procedure.

“The team working together has decreased the preoperative and intraoperative inconsistencies,” Lortscher says.

—Judith M. Mathias, RN, MA

Watch a video of the Sacred Heart MRI OR at www.sacredhearteauclaire.org/smartor