Drs. Steinbock (left) and Bell and various pieces of Norton Hospital's new da Vinci Surgical System.

Robotic Redeemer

A remote-controlled, computer-assisted surgical breakthrough called da Vinci is heralding in a new era for minimally invasive surgery. By Jonna Lilly

Dressed in scrubs, "blue hair" and a surgical mask, I entered Norton Hospital's OR 1 this past June to witness a radical prostatectomy (the removal of a cancerous prostate gland) using a minimally invasive new robotic tool called the da Vinci Surgical System. Just as standard laparoscopic procedures, begun in the mid 1980s, revolutionized abdominal surgery, so too has the computer-assisted, remote-controlled da Vinci, brought to the medical market in 1998 by a California-based company called Intuitive Surgical, revolutionized laparoscopy.

State-of-the-art technology abounds in the new system, which is made up of three principal components — a surgeon's console, positioned a yard or two away from the operating table; a four-armed robotic device set up at the patient's side; and a cart holding image-processing equipment. Plugged into the tips of three of the da Vinci's robotic arms are interchangeable, motor-driven EndoWrist microinstruments designed to perform specific tasks — scissoring, grasping, cauterizing, cutting, suturing. The fourth tip holds twin high-resolution zoom lenses and a light source, affording the surgeon a bright, three-dimensional view of the body's interior (a huge improvement over the single-lens, two-dimensional view of standard laparoscopy). Everything is electronically linked to the surgeon's console, where he views the surgical site through binocular eyepieces and controls the EndoWrists' twists, turns and snips with left- and right-hand devices somewhat akin to the joysticks in a PlayStation game.

The microinstruments are equipped with a quick-release lever that swiftly disengages them when an instrument change is required. Computer software is programmed to mimic the surgeon's hand movements precisely and eliminate any tremors caused by strain or fatigue. In short, the robotic arms become the surgeon's surrogate, an assistant that — because both "hands" and instruments are dramatically reduced in size — can perform in ways he cannot.

The two urological surgeons who invited me to observe the prostatectomy, Drs. Greg Steinbock and Brad Bell, partners at Metropolitan Urology and affiliated with Norton Healthcare and the University of Louisville, lobbied hard for Norton to purchase a da Vinci, realizing that it heralded a significant improvement in surgical capabilities for this region. (The downtown Norton is the only local hospital with a da Vinci.) The Steinbock-Bell team has performed approximately two da Vinci operations per week since the beginning of this year, the majority of them prostatectomies, although two of the surgeries were performed on children ages 8 and 14 with congenital kidney defects. The Food and Drug Administration has also cleared da Vinci's use for certain cardiac and gynecological surgeries.

Given the high-tech nature of the new laparoscopic system, both doctors trained extensively on the da Vinci, including a classroom course, observations of surgeries around the country, practice cases on cadavers, and supervision by an on-site mentor who coached their first four surgeries.

From the surgeon's console (left) Steinbock directs the mini-maneuvers of da Vinci's "hands."

VIABLE CANDIDATES FOR robotic prostatectomies need to meet certain criteria. "Patients should be 70 or less and have been diagnosed with localized, organ-confined cancer," Dr. Steinbock told me. "In addition, because of the length of the surgery, they should be able to tolerate the anesthetic for a longer time period. Those weighing over 275 pounds would be ineligible."

Warren Thornsberry, a 51-year-old worker at the Ford Motor Company Assembly Plant, fit the bill. He and his wife, a registered nurse, researched extensively before deciding on robotic surgery. To them, "it was the simplest and easiest route." He was also in need of a hernia repair, caused by heavy lifting. This first laparoscopic procedure was performed by general surgeon Dr. Matt Brown without the assistance of the da Vinci.

I arrived in OR 1 at 8 a.m., with the hernia repair already under way in a darkened room lit only from a bright light above the patient and monitors displaying two-dimensional views of the interior of the patient's abdomen. An hour and 15 minutes later, Brown finished the hernia repair and left the OR.

Then, with music from radio station 102.3 "the Max" playing softly in the background, Steinbock and Bell began the first step in the robotic process: opening five ports (incisions), from eight to 12 millimeters long, into which the robotic arms (and one manually held arm for the assistant surgeon) would be inserted. However, because a hernia repair is a laparoscopic procedure involving port openings, the doctors chose to use two of those and opened only three new ones.

Bell, the lead surgeon for the operation (the partners alternate roles for each such surgery), took his seat at the da Vinci console while Steinbock positioned himself on one side of the patient. The other medical personnel in the room included an anesthesiologist and two surgical nurses. With Bell's eyes glued to the console's binocular viewing system and his hands busy with the joysticks, Steinbock would be responsible for changing the instruments on the robotic arms as needed and monitoring the overall procedure.

Bell asked that the robotic-arms cart, then in the back of the room, be pushed forward, over the patient's abdomen opposite Steinbock. A nurse complied, and the surgeons docked the apparatus, positioning the robotic arms above their respective ports. To ensure easy access to the surgical target area, and to discourage profuse bleeding, the abdominal cavity — surrounded by a membrane called the peritoneum — was inflated with carbon dioxide gas, distending the patient's belly and eliminating any need to "fish" the camera tube and microinstruments through obstructing viscera.

The microinstruments were then slid into the robotic arms, along with the camera-and-light tube, and inserted into the patient's body. At 9:31, Bell took his place at the surgeon console. First, he began to separate the patient's bladder neck from the diseased prostate. He worked intently, stopping once to let me take a look through the binocular viewfinder. The console's 3-D vision system provides excellent depth perception and is ultra-crisp, so I felt like I had actually stepped inside the patient's body.

Steinbock asked me to move my chair forward so that I was essentially sitting on his left. From that vantage point, I could see three 2-D monitors positioned around the patient, although the picture on any of them couldn't compare to the one I had just seen inside the surgeon console.

Close to 10 a.m., Steinbock politely asked a nurse to notify the patient's wife that it would be another two hours before the surgery concluded. "We take our time to have a positive outcome," Bell said.

Next, Bell began cutting to the vas deferens. His partner quizzed me about the function of the vas deferens; I had to confess that my copy of *Gray's Anatomy* was slightly dusty from disuse. He told me that it is the tube that carries sperm to the urethra. Seminal fluid is produced in two small glands called the seminal vesicles, which are excised, but "we don't get too frisky with removing all of them because it's risky," Steinbock said. The

reason: Nerve bundles in the surrounding area affect continence and sexual function.

At 10:26, Bell began cutting around the bottom of the prostate, carefully avoiding the nerve bundles. Some bleeding occurred, which necessitated tying off a cut vessel. Still, the amount of bleeding was miniscule compared to other types of surgery.

The next step involved transecting, or cutting across, the prostate and removing it by "pouching" it and bringing it out of the abdominal cavity through one of the auxiliary ports. Steinbock advised that more suturing take place "for security" to nullify any excessive bleeding. "Suturing is very difficult in traditional minimally invasive surgery, but the robot makes it easier," Steinbock said, because of the tiny size and amazing flexibility of the da Vinci microinstruments. The EndoWrist name is well-assigned — the robotically controlled cutters, tweezers and graspers are as deft in their movements as the human wrist, scaled down to micro-size.

Next, Bell began reconnecting the bladder neck to the urethra, sewing in a counterclockwise direction. At 11:34, a draining catheter was inserted into the patient's abdomen to aid in healing; it would be removed in several days, once dry healing had begun. Steinbock declared this a "critical moment" for Bell as he maneuvered the robotic arms. The reason: The seal between the bladder neck and the urethra must be watertight. If it isn't, urine will leak, causing the patient extreme discomfort.

Exactly seven minutes later, after intently watching the monitor to his left, Steinbock pronounced the catheter's placement as "perfect." At that point, the da Vinci's job was finished. Bell left the surgeon console and took his place on the patient's right. He asked that the lights be turned back on at 11:43 and the robotic arms disengaged. The surgeons closed the five ports as the nurses counted the instruments and other supplies that had been used. One of the nurses then cleaned the incisions as the team readied for the next patient, the second of three having robotic surgery that day.

The end result: The patient had four internal sutures, approximately a teaspoon of blood loss, and was prostate-cancer-free. Moreover, he could expect a quick recuperation time, even though this surgery had been the "most difficult so far," Steinbock said. He teased me, saying, "Watch one, do one!"

After looking at the patient's black-speckled, diseased prostate in Bell's hand, I left the OR in utter amazement at 12:15. A complex procedure involving both man and machine had been made to look incredibly simple, thanks to both surgeon and engineering prowess. ■