GUESTEditorial

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Urology: Engineered for the New Millennium

This is the fourth of a 12-part series: This year we're focusing on the phenomenal progress that the medical community has made in the 30 years of Federal Practitioner's *existence. Each month we'll feature an editorial written by one of our Editorial Advisory Association members, reminding us how much has changed in their particular medical field over the past 30 years. This month's focus is urology.*

As I considered the myriad of advances made in the field of urology over the last 30 years, it became clear that the majority of these advances have been in technology. Major developments in instrumentation, in particular, have spawned the emergence of entirely new subspecialties. Further, new compounds produced through materials engineering have allowed urologists to improve on and expand the arsenal of devices for the management of urologic disorders.

The earliest urologists were notoriously known as lithotomists, the practitioners who "cut for stone," but contemporary specialists have come a long way from those infamous beginnings. Open surgery for stone disease is now rare, as urologists have a multitude of instruments for minimally invasive therapy of urinary stones as well as congenital anomalies, obstructive processes, and urologic malignancies. During the 1980s and 1990s, due to advances in optics, materials, and manufacturing, cystoscopy and ureteroscopy entered the modern era. Urologists graduated from large, rigid cystoscopes and ureteroscopes that could not bend to accommodate the natural curves of the urinary tract to flexible, fiber-optic instruments that are gentler on the urinary tissues, producing fewer strictures and greater patient comfort. Modifications of the devices, as well as numerous instruments (eg, lasers), greatly enhanced the urologists' ability to treat many disorders in a minimally invasive fashion.

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In the realm of minimally invasive surgery, the adaptation and modification of laparoscopy for urologic use in both adult and pediatric urologic surgery has burgeoned in recent years. Needless to say, urologic laparoscopy has been greatly helped by the operative robot. This device, FDA-approved in 2000, consists of 4 articulating arms attached to a central "side cart." The surgeon no longer works at the patient's side but rather sits at a remote console directing the robot using 3-D visualization via a 2-lens camera, as well as 2 hand and 2 foot controls. The robot allows greater operative precision and optimal visualization of the operative field.

But wait, there is more! If it were possible to award a Nobel Prize for the most significant innovation of the 20th century, it would have to go to the German urologist, Christian Chaussy, MD, and the former aeronautics giant Dornier MedTech Systems GmbH for jointly developing extracorporeal shock wave lithotripsy. It was observed that the skin of airplanes exhibited pitting after the planes broke the sound barrier. Somehow it was decided to apply this observation to the treatment of urinary calculi in situ. It was correctly postulated that the tissues of humans, consisting largely of water, would conduct shock waves with relative impunity; but when the shock waves hit a solid structure such as a stone, the transmitted energy would fracture and ultimately pulverize the object. In the case of calculi, the fragments would then be flushed out by the natural flow of urine. After successful testing in animals, a large device consisting of a water bath to transmit the shock waves, a gantry to hold the patient, a fluoroscopic head to visualize the stones, and a spark gap generator to produce the shock waves was developed for human use. It proved effective in treating renal and ureteral

calculi and after FDA-approval in 1984 was rapidly adopted throughout the U.S. Subsequent iterations of the device have eliminated the water bath, allowing for greater mobility and the ability to use the device at multiple sites. The newer machines have also been engineered to use other types of generators (electromagnetic, piezoelectric) to produce the shock waves. This is truly a noninvasive therapy that has revolutionized the management of stone disease, one of the oldest scourges of the human race.

The late 20th century has been termed the *PSA era* by urologic oncologists after the identification of prostatic specific antigen (PSA) in the seminal plasma. The enzyme is a serine protease in the kallikrein family whose sole function is to liquefy semen and facilitate fertilization. It was soon recognized that PSA levels in the blood were elevated in the presence of prostate cancer, making it a marker for the disease. The first commercially available assay was released in 1986. The combination of digital rectal examination and PSA levels were found to be more effective for the diagnosis of prostate cancer than either alone. Further, PSA levels were found to be useful for risk stratification and posttreatment monitoring.

Today, although PSA levels retain their usefulness in prostate cancer surveillance, their use for the detection of prostate cancer has become a subject of controversy. It has long been appreciated that the majority of prostate cancers behave indolently. Screening, therefore, detects a number of patients who have low-risk disease. Such men may be overtreated, causing unnecessary morbidity. At this time, urologists do not have a reliable way to determine who is at risk for this lethal disease. Therefore, current guidelines state that physicians should counsel their patients regarding the pros and cons of PSA screening so that they can decide for themselves whether or not to be screened. For urologists, PSA screening remains a useful tool. Studies have shown that PSA detection results in decreased prostate cancer mortality. As our knowledge of PSA levels and their relationship to prostate cancer has matured, urologists have come to appreciate the fact that other PSA-based criteria can prove useful in detecting clinically significant prostate cancer.

Currently, the absolute value of the PSA level is not as important as the rate of change known as the PSA velocity. A rapid linear rise in PSA levels strongly suggests prostate cancer and usually mandates a biopsy. Urologists must continue to rely on PSA-based algorithms in the diagnosis and management of prostate cancer, but the hope for the new millennium is that research efforts will lead to the detection of markers that will allow urologists to focus on identifying and treating the men who are most at risk from this disease.

When it comes to male reproductive health, no one can discount the revolutionary effect of the first PDE-5i, sildenafil, on the treatment of male sexual dysfunction. For the first time, urologists had an oral agent to treat this common problem. Prior to 1998, when sildenafil was approved, urologists could only offer a vacuum device, implants, or penile injection therapy. Men who were previously reluctant to pursue therapy because of the invasiveness of the options now had a much more desirable alternative. The revolution has now subsided, and urologists currently have an intraurethral alprostadil suppository and several more PDE-5is with which to treat erectile dysfunction.

Voiding dysfunction, aside from that caused by BPH, may be complex in origin and refractory to conventional therapies. Many years ago, Dr. Emil Tanagho and Dr. Richard Schmidt of the University of California, San Francisco, dreamed of creating a device to correct such voiding disorders. Their efforts reached fruition in 1997 when the FDA approved the first-ever device for sacral neuromodulation known as InterStim®. It was initially indicated for intractable urgency-frequency and urgency incontinence as well as for urinary retention. Its exact mechanism of action is not understood, but it is believed to modulate the effects of sacral afferent inflow on storage and emptying reflexes. Magically, often as soon as the device was turned on, patients in retention could urinate; those voiding too frequently were able to postpone urination for long periods; and those that had leaked were dry. Initial fears regarding durability have been allayed over time, and last year, the FDA approved the device for use in fecal incontinence as well.

Urologists have clearly reaped the benefits of the technologic advances achieved over the last 30 years, and the further evolution of urologic practice is certain to be engineered by continued innovation. ●

Author disclosure

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