Robotic Surgery of the Kidney, Bladder, and Prostate

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KEYWORDS

• Robotic • Laparoscopic • Partial nephrectomy • Pyeloplasty • Cystectomy
• Prostatectomy

KEY POINTS

- Minimally invasive surgery offers many advantages over the traditional open approach, including improved cosmesis, reduced blood loss, decreased pain, shorter hospital stays, and improved convalescence.
- Robot-assisted surgery offers the advantages of a minimally invasive approach with greater technical ease and a shorter learning curve than pure laparoscopy.
- Fueled by the success of the robot-assisted laparoscopic prostatectomy, Urologists are increasingly using the robotic platform for other advanced operations involving the kidney, ureters, bladder, and prostate.
- Robotic surgery has been shown to be safe and effective, with good perioperative, functional, and oncologic outcomes.
- Although cost continues to be a major concern regarding the use of robotic technology, improved efficiency and reduced hospital stays associated with the minimally invasive approach are allowing for better cost-effectiveness.

INTRODUCTION

Robot-assisted laparoscopic surgery has been one of the most important recent technological advances in the practice of surgery. In particular, urology has a long-standing history of embracing advances in surgical technology and many urologic procedures have been replaced with more minimally invasive techniques, both endoscopic and laparoscopic, with the goal of reducing perioperative morbidity (**Table 1**). Advantages of the minimally invasive approach include increased precision, smaller incisions, reduced intraoperative blood loss, decreased postoperative pain, shorter hospital stays, and improved convalescence while preserving functional and

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Table 1
History of minimally invasive urologic surgery

Year	Description
1870	Simon: First open partial nephrectomy
1886	Trendelenburg: First reconstruction for ureteropelvic junction obstruction
1887	Bardenheuer: First open cystectomy performed
1900	Freyer: First open simple prostatectomy
1905	Young: First perineal prostatectomy
1947	Millin: First radical retropubic prostatectomy
1949	Marshall and Whitmore: First open radical cystectomy, pelvic lymphadenectomy described in detail
1949	Anderson and Hynes: First open dismembered pyeloplasty
1982	Walsh: First nerve-sparing open radical retropubic prostatectomy
1983	Arthrobot introduced for orthopedic procedures
1985	PUMA 560 introduced for computed tomography–guided brain biopsy
1988	ROBODOC introduced for hip arthroplasty
1988	PROBOT introduced for transurethral prostate surgery
1992	Schuessler: First laparoscopic radical prostatectomy
1992	Parra: First laparoscopic simple cystectomy
1993	Automated Endoscopic System for Optimal Positioning (AESOP) introduced
1993	Winfield: First laparoscopic partial nephrectomy
1993	Sanchez de Badajoz: First laparoscopic radical cystectomy
1993	Kavoussi and Schuessler: First laparoscopic pyeloplasty
1998	ZEUS and da Vinci Surgical Systems introduced
2000	Approval by the Food and Drug Administration of the da Vinci Surgical System for use in laparoscopic surgery
2000	Abbou: First robotic prostatectomy
2002	Mariano: First laparoscopic simple prostatectomy
2002	Gettman: First robotic pyeloplasty
2002	Menon: First robotic cystectomy
2003	Intuitive Surgical, Inc buys Computer Motion, Inc
2004	Gettman: First robotic partial nephrectomy
2008	Sotelo: First robotic simple prostatectomy

oncologic outcomes. Although standard laparoscopy has been shown to improve outcomes for some urologic surgeries, for example, radical nephrectomy, its adoption for reconstructive procedures has been limited due to the technical challenges and steep learning curves. In addition, traditional laparoscopy may be associated with losses of depth perception, intuitive movement, and dexterity. Robotic surgery with the da Vinci Surgical System (Intuitive Surgical, Inc, Sunnyvale, CA) has grown rapidly through its use in operations that benefit from a minimally invasive approach, but are technically challenging to perform with pure laparoscopy. The robotic system overcomes many of the limitations encountered in standard laparoscopy and offers a reduced learning curve. The advantages of robotic assistance were first noted in urology with the robot-assisted laparoscopic prostatectomy,[1,2] whose wide acceptance and popularity has led to other advanced robotic surgeries, in both adults and children, involving the kidney, ureter, bladder, and prostate (**Table 2**).