Robot-Assisted Cystectomy: Getting Started: Prior Experience, Learning Curve, and Initial Patient Selection

3

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None of our men are 'experts.' We have most unfortunately found it necessary to get rid of a man as soon as he thinks himself an expert because no one ever considers himself expert if he really knows his job. A man who knows a job sees so much more to be done than he has done that he is always pressing forward and never gives up an instant of thought to how good and how efficient he is. Thinking always ahead thinking always of trying to do more brings a state of mind in which nothing is impossible. The moment one gets into the 'expert' state of mind a great number of things become impossible.

—Henry Ford

Introduction

The task of learning and incorporating robot-assisted cystectomy into a busy surgical practice is a daunting proposition, particularly for surgeons well versed in open surgical techniques. The promise of a minimally invasive alternative to open surgery, especially for bladder cancer, is significant due to the purported benefits of fewer complications, decreased blood losses, and a shorter hospital stay. The development of robot-assisted cystectomy represents the first widespread challenge to open cystectomy. Yet, the procedure remains technically challenging even for surgeons experienced in robot-assisted pelvic surgery. Indeed, how does a surgeon transition from a practice dominated by open surgery to one that offers the benefits of minimally invasive surgery?

Abandoning one technique with which a surgeon is comfortable, and transitioning to another in which that surgeon is a novice, creates potential concerns regarding ethical responsibility, patient safety, oncologic efficacy, and surgical training. This task seems particularly intimidating in the group of patients undergoing surgery for invasive urothelial carcinoma, where few salvage therapies exist for those with inadequate initial surgical extirpation. Furthermore, the patients themselves frequently possess significant medical comorbidities making lengthy and complicated procedures undesirable.

With these concerns in mind, it is important for the entire surgical team to prepare for the challenges of robot-assisted bladder surgery prior to the first case. Critical members of this surgical team include all of the personnel that bring this procedure to clinical fruition in the preoperative, intraoperative, and postoperative setting. In this chapter, we review our experience in converting a high volume practice with robotic prostatectomy and open radical cystectomy to one that offers robot-assisted cystectomy. In addition, we describe some technical modifications to both robot-assisted radical prostatectomy and open radical cystectomy that made our transition to

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robot-assisted cystectomy easier. Finally, we review the existing literature regarding the evidence for a learning curve in robot-assisted cystectomy and provide tips for surgeons embarking upon their initial experience in robot-assisted bladder surgery.

Initial Patient Selection: The Ideal Patient

We remain convinced that the ideal patient exists who does not have medical comorbidities, is at their ideal body weight and poses no unsurprising demographic, anatomic, or pathologic characteristics. However, we are equally convinced that the ideal patient does not need to have their bladder removed or have bladder cancer. While that ideal patient may not be available there are certain factors within your control to maximize outcomes with robot-assisted cystectomy. Optimal patient selection can reduce operative time and complication rates for a surgeon's initial experience. Yet, this desire lies in direct contradiction to the reality that most patients that require a cystectomy have invasive bladder cancer and most patients present with significant comorbidities. There is an important balance between identifying perfect candidates for the early robot-assisted cystectomy experience and maintaining adequate case volume to prevent catastrophic complications as well as to develop and maintain surgical expertise that must be considered.

We recommend beginning with patients who are not obese and may require a simple cystectomy for chronic cystitis or a nonfunctional bladder. Additionally, while the female pelvis is generally more accessible and less confining than the male pelvis, many urologists are more comfortable beginning the operation in men due to extensive experience in robotic-assisted radical prostatectomy. Based on the rarity of simple cystectomy, the next patients that should be considered ideally have non-bulky urothelial disease with organ confined, low tumor burden, with no identifiable lymphadenopathy on preoperative imaging, and who do not have significant cardiopulmonary disease. Patients should have no evidence of extravesical disease, history of prior pelvic surgery or radiation, as these complex cases are better treated after the robotic team has gained significant experience. Neoadjuvant chemotherapy is becoming more commonplace and can decrease the tumor burden to aid in patient selection, but it is important to wait a sufficient time (4 to 6 weeks) to allow adequate patient recovery prior to surgical intervention. Infact it has been shown in a retrospective series that waiting up to 10 weeks after neoadjuvant chemotherapy did not adversely affect oncological outcomes at time of cystectomy [1].

Patient height, weight, and body habitus are important considerations in early patient selection. For patients with a body mass index exceeding 35 kg/m^2, it can be more difficult to identify landmarks, expose the necessary structures, pass instruments, and it may be more problematic to maintain Trendelenberg positioning for the duration of the case. Central obesity can pose significant challenges of instrument reach and trocar placement, even with extralong trocars available. The normal robotic trocars are 100 mm in length, while the extralong trocars are 150 mm in length. Additionally, for larger patients undergoing intracorporeal urinary diversion, the thick broad mesentery may present a unique challenge as staple loads may not adequately provide hemostasis.

Finally, consideration of prior abdominal surgery and radiation are important. While experienced surgeons may be able to complete these procedures safely, patients with multiple prior abdominal operations are at an increased risk of intraoperative complications. This tends to occur most commonly with accessing the abdominal cavity in the face of multiple prior midline surgeries where adhesions are present or after ventral hernia mesh repair. If these cases are selected for the robot-assisted approach, it is advisable to first gain some experience and comfort with the technology and the steps of the procedure before embarking on these demanding circumstances. The preferred method of access is with direct visualization utilizing the Hassan technique [2] or in other circumstances putting a 5 mm trocar and laparoscope in a naïve part of the abdomen to access the feasibility of proceeding with normal trocar placement. Similarly, just as in open surgery, patients with a history of prior pelvic radiation are at increased risk of perioperative complications and should be informed of the small but real risk of bowel injury requiring a fecal diversion. Indeed, patients with a history of prostate cancer are more likely to require bladder cancer surgery. While we have completed these procedures in patients with prior prostate irradiation and prior radical prostatectomy, these operations are significantly more complicated and necessitate the maintenance of good oncological principals to prevent tumor spillage. When embarking on a new program in robot-assisted bladder cancer surgery, it is best to initially avoid patients with extensive prior abdominal surgery and patients with a history of pelvic irradiation.

The Decision to Offer Robotic Bladder Cancer Surgery

The decision to offer robot-assisted bladder cancer surgery is a difficult one; particularly while randomized trial data demonstrating significant benefits are immature. Robot-assisted radical cystectomy (RARC) is significantly different than other robot-assisted procedures. For example, even the highest volume radical cystectomy centers usually perform fewer than 200 radical cystectomies annually (an annual incidence in the USA of less than 10,000) [3]. This contrasts with over 100,000 radical prostatectomies and greater than 600,000 hysterectomies performed annually in the USA [3, 4]. Therefore, the decision to pursue robot-assisted bladder cancer surgery must be considered in the context of medical centers that offer robotic surgery for other disease states. It is unlikely that robotic bladder cancer surgery alone will be sufficient to justify the substantial initial capital investment required for robotic surgery [5, 6]. Furthermore, adequate surgical volume is necessary to improve upon the learning curve [7, 8]. Frequent robotic procedures allow the entire robotic team (including nurses, assistants, technologists, anesthesia providers, and surgeons) to exercise ease and expertise with the fundamentals of the robotic set up, anesthetic concerns, positioning, and technique. Most urologists have the capability and comfort of performing robot-assisted radical prostatectomy, and such an experience is critical in starting to offer robot-assisted bladder surgery. The number one priority of any operation, especially for one as deadly as bladder should be the quality of the operation rather than the approach, and it is a display of good judgment by the surgeon if they recognize the failure to progress and convert the operation to an open approach before risking unnecessary complications or outcomes.

The Robotic Team

Surgeons who perform open or robotic bladder cancer surgery are dependent upon a number of other providers, each of whom has an important role to optimize patient care. We organized our robotic bladder cancer team around the individuals that assist in robot-assisted radical prostatectomy (Table 3.1). This team includes nurses, a Certified Surgical Technologist, a Certified Surgical Assistant, specific anesthesiologists, urology residents or fellows, and a fellowship-trained surgeon. We found it extremely helpful to travel with critical members of this team to other hospitals completing these procedures to observe and ask task specific questions to lessen anxiety before beginning the procedures ourselves. Each member of the robotic team was able to focus upon their role in making the procedure work and

Table 3.1 Characteristics of a successful robot-assisted radical cystectomy team

Comfort with steps of robotic prostatectomy
Experience with open radical cystectomy and urinary diversion
Laparoscopic experience
Understanding of patient positioning
Review of other surgeon experience
Anesthesiology support
Ease in troubleshooting robotic issues
Monitoring of surgical results

transfer that experience to our institution. Additionally we found it helpful to perform mock procedures in our operating room setting to rehearse member specific roles and responsibilities to ensure a smooth transition to our first patient. Finally, during the initial 20–30 cases, our team modified the procedures based on experience and observation of what worked at our institution to develop a consistent technique.

While the surgeon receives most of the accolades and burdens for the outcomes of these procedures, the bedside assistant is a particularly important member of the surgical team. We have used both urology residents and fellows, but also found that having a dedicated surgical assistant is helpful. These assistants provide some stability to the surgical team. Whoever fills the role of bedside assistant; it is important that they are comfortable with basic laparoscopic techniques, safe torcar placement, suctioning, tissue handling, retraction, placement of clips, passing suture material, and providing essential exposure. These are not easy tasks and are not quickly mastered by assistants that are infrequently exposed to robotic or laparoscopic procedures. Therefore, consistency and repetition in this role is particularly important.

Similarly, anesthesia providers play a critical role in the successful completion of these procedures. Registry data has shown that about 60 % of all new cancer patients older than 65 years suffer form at least one other serious disease [9]. Bladder cancer patients frequently have comorbid health conditions that directly impact parts of the procedure. For example, the prevalence of chronic obstructive pulmonary disease (COPD) is common in both men (19 %) and women (8.9 %) with bladder cancer [10], likely secondary to the increased risk of disease associated with smoking. This has significant implications upon pneumoperitoneum and carbon dioxide retention. Similarly, obesity in combination with steep Trendelenberg positioning can create increased pulmonary pressures. Furthermore, patients must be draped and padded in such a fashion that they will not suffer complications from the extended duration of these procedures. Techniques to manage these potential issues are critical to the successful completion of the procedure and to prevent unnecessary complications.

Finally, circulating and scrub nurses are critical to the efficient completion of these cases. They are responsible for the efficient sterile draping of the robotic arms and preparing the patient and robot for the procedure. They are also needed to quickly and accurately identify and provide equipment and supplies that are commonly required for the completion of these procedures. Quick and efficient nursing practice can alter a procedure from lasting many hours to one that provides efficient and improved patient care.

The ability of the team to effectively communicate and prepare for these procedures will play a major role in patient safety and the quality of the surgical intervention. The integrated approach and education of all the team members is essential to the successful adoption of robot-assisted bladder surgery.

Lessons to Take from Prior Surgical Experience

As discussed previously, comfort in robot-assisted pelvic surgery, specifically robot-assisted radical prostatectomy, is a prerequisite for a urologist looking to add robot-assisted bladder cancer surgery to their armamentarium. While significant and important differences between the procedures exist, experience gained from robot-assisted radical prostatectomy translates to robot-assisted bladder cancer surgery particularly with respect to pelvic lymphadenectomy, neurovascular bundle preservation (if performed), and apical prostate dissection. Furthermore, ease and understanding of basic robotic maneuvers (such as suturing, knot tying, and cautery) and visualization (with different angle lenses) within the confines of the pelvis facilitates quicker adaptation for the surgeon and the surgical team alike. Finally, the anatomic approach and landmarks in the pelvis are exactly the same. For these reasons, we feel that comfort with robotic radical prostatectomy is critical prior to adopting robotic bladder cancer surgery.

Similarly, familiarity and comfort in performing open radical cystectomy with urinary diversion are a prerequisite in adapting the robot assisted approach. Such familiarity is obviously critical should a conversion to open radical cystectomy be necessary. Beyond that, however, the basic surgical and oncological principles and anatomy are similar between the open and the robotic approaches. Finally, the majority of surgeons starting an experience with robot-assisted radical cystectomy perform the urinary diversion in an open fashion. Therefore, expertise with open urinary diversion is imperative as it may be performed through a smaller incision, an incision positioned higher in the abdomen, and/or from a different angle.

While many of these concepts are discussed in detail elsewhere in this text, it is important to highlight portions of both open cystectomy and robotic prostatectomy that impact upon a surgeon transitioning to a practice offering RARC. The specific technical aspects of the procedure are discussed in detail throughout this textbook and are beyond the scope of this chapter. However, there are several important points that relate to prior experience and starting a robot-assisted cystectomy program that warrant discussion. Therefore, here we outline several portions of both RARP and open cystectomy and discuss how they impact the adoption of RARC.

Surgical Concepts to Bridge RARP to RARC

Lymphadenectomy

Lymphadenectomy is likely the most difficult portion of RARC for most practitioners to master. While the importance of an extended pelvic lymphadenectomy is debatable for patients with prostate cancer, its importance for patients with invasive urothelial carcinoma is well established. Numerous studies have now demonstrated improved survival with extended lymphadenectomy and adequate nodal dissection templates are vital. Indeed, lymph node yield is perhaps the most commonly utilized marker of surgical quality. Therefore, it is critical for surgeons embarking upon RARC to perform an adequate lymphadenectomy and also demonstrate comfort with the extent and degree of lymphadenectomy necessary for patients with invasive bladder cancer.

As high-volume RARP providers, we found it helpful to extend the boundaries of lymphadenectomy during RARP for patients with intermediate- and high-risk prostate cancer. This allowed more familiarity with handling the pelvic vessels and allowed us to develop safe and efficient techniques for dealing with bleeding situations. Over time, we expanded our RARP practice to routinely include lymph node packets in the obturator, internal iliac, and external iliac regions. We found it useful to begin this dissection posteriorly to the iliac vessels between the lymph node packet and the pelvic side wall. This experience was important in developing and maintaining a program in RARC due to the huge volume discrepancies that exist between RARP and RARC.

Posterior Dissection

Dissection of the seminal vesicles and developing a plane between the prostate and the rectum are essential components of RARP as well as RARC. While we have typically performed the seminal vesicle dissection during RARP from an anterior approach, familiarity with the transperitoneal posterior-based approach to RARP would facilitate the conversion to RARC. Posterior-based approaches to RARP enable surgeons to more accurately identify the vascular pedicles at the time of RARC as well as to perform selective neurovascular bundle preservation during RARC when clinically appropriate. We found it helpful after performing the ureteral dissection and lymphadenectomy with the 30° lens that switching to the 0° lens enabled more caudal dissection between the prostate and the rectum during RARC where it was almost possible to reach the apex of the prostate. This caudal dissection is important during RARC as it decreases the risk of rectal injury and enables easier dissection for the remainder of the procedure. Furthermore, the sheer bulk of a cystoprostatectomy specimen is much more challenging to manage after the bladder has been dropped off the anterior abdomenal wall (we would recommend this as one of the last steps in RARC) than the smaller specimen obtained at the time of prostatectomy. This bulk makes the cystoprostatectomy specimen more difficult to maneuver particularly for residual posterior and rectal attachments.

Anterior and Apical Dissection

Developing the space of Retzius and dissection of the apex of the prostate are routine procedures during both RARC and RARP. Surgeons comfortable with RARP should be able to transition these skills easily to RARC. Differences do exist, in part due to location of the tumor and the possibility of extravesical disease that make comfort with this portion of the procedure important. Specifically, surgeons must be comfortable with subtle modifications of the anterior dissection to ensure a negative surgical margin, even in patients with anterior-based T3 tumors. Furthermore, apical dissection remains important (particularly in the setting of orthotopic urinary diversion), though surgeons comfortable with control of the dorsal venous complex and apical prostate dissection should be able to transfer this to their expertise expeditiously. Unlike in prostatectomy it is important to prevent urine spillage. For this we recommend that after the prostate apex has been carefully dissected that the urethra be identified so that a large Hemo-o-lok® polymer clip (Teleflex, Limerick, PA) or stapler can be used to ensure a hermetic seal and prevent possible tumor or urine leakage after removal of the Foley catheter.

Surgical Concepts Bridging Open Cystectomy to RARC

Lymphadenectomy

Just as comfort with lymphadenectomy from a robotic approach is important when starting RARC, familiarity open pelvic lymphadenectomy is important. This experience is critical to define and replicate the landmarks and limits of dissection. Cystectomy surgeons have for years defined the role of extended lymphadenectomy and it is critical not to lose any progress that may influence the outcome from the disease and intervention. Accordingly, lymphadenectomy at a minimum should include the obturator, internal iliac, external iliac, and distal 1/3 of the common iliac. We recommend that extended pelvic lymphadenectomy be performed as the new standard to include all lymphatic tissue including the common iliacs, proximally to the aortic bifurcation and pre-sacral tissue as well [11]. An important landmark that we use to limit the cranial aspect of the dissection is the take off of the inferior mesenteric artery (IMA).

Control of Vascular Pedicles

One of the primary advantages of robot assistance during cystectomy or prostatectomy is decreased venous bleeding, largely attributed to the pneumoperitoneum used during the procedure. However, even patients undergoing RARC may experience significant bleeding. Nearly 20 % of patients in the International Robotic Cystectomy Consortium report receiving a blood transfusion. Therefore adequate control of the vascular pedicle to the bladder and prostate is critical.

We have found that Hemo-o-lok® polymer clips (Teleflex, Limerick, PA) are useful in this setting as they provide a secure mechanism to control the vascular pedicles. Laparoscopic staple devices are also useful in this setting. The development of a robot-assisted stapler device is underway, but we have not used this device to date. Alternative energy sources are also useful adjunctive measures to provide hemostatic control. Indeed, one of the first modifications we made to our robot-assisted cystectomy procedure was the addition of a LigaSure™ device (Covidien, Boulder, CO) for the vascular pedicle and the bowel mesentery. The combined force and energy application with the tissue sensing impedance allows for excellent hemostasis, minimal char, and efficient progress of the procedure. Other advanced energy platforms compatible with the robot-assisted approach include: monopolar and bipolar cautery, mechanical (harmonic), and lasers.

Urinary Diversion

Most surgeons early in their adoption of robot-assisted radical cystectomy perform the necessary urinary diversion through an open approach.

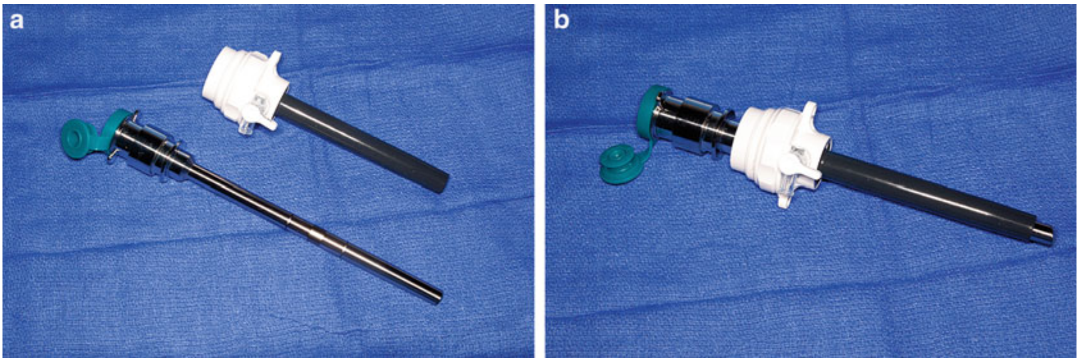

Fig. 3.1 Configuration of lateral port for intracorporeal diversion. (**a**) Standard 10–12 mm laparoscopic port with extralong robotic trocar. (**b**) Robotic trocar going through 10–12 mm port

Indeed for the first 20–30 of these cases, we felt most secure performing the urinary diversion through an open approach. This allowed us to focus our initial robotic experience exclusively upon the cystectomy and pelvic lymphadenectomy. It is useful to first start RARC by identifying the ureters and doing the proximal and distal dissections first. This will help to identify relevant vascular structures and provide important landmarks for the rest of the procedure. We would recommend that the proximal dissection of the left ureter be taken more proximally than you would normally perform, being sure to take a wide margin of tissue around the ureter in order to provide as much vascular supply as possible. If you do your diversion extracorporally the extra length of the left ureter will prevent traction injury and potential vascular compromise as it transverses below the mesentery to limit the potential for the subsequent development of an anastamotic stricture. It is also helpful to pre-tag the Hemo-o-lok® polymer clips (Teleflex, Limerick, PA) with different colored suture so that they can be readily identified later in the case. Proximal and distal uses of these clips on the ureter prevent urine or tumor spillage and allow immediate frozen section pathological analysis of the ureteral margin.

When transitioning to an intracorporeal urinary diversion, we found it helpful to have the assistant on the left side of the patient. The angle from the left side of the patient makes division of the ileal bowel segment and its associated vascular supply much easier. However, this is in contradiction of our normal practice of having the surgical assistant on the right side of the patient for RARP. Therefore, we place a 10–12 mm laparoscopic port in the left lateral-most port site and kept the surgical assistant on the right. It is then quite easy to deploy the normal or even extralong robotic port through this laparoscopic port, making sure to align with the rotational point (Fig. 3.1a, b), without compromise of the pneumoperitoneum. Then, a second surgical assistant may scrub in for the urinary diversion, or the surgical assistant on the right may transition over to the left to complete any necessary staple work on the bowel or associated mesentery. We have found this approach to be beneficial in allowing us to maintain our expertise in RARP while incorporating the techniques and experience into the practice of RARC. It is also helpful to first identify the relevant segments of the bowel (depending on the planned type of diversion) and tagging them with different colored sutures at the beginning of the case prior to any dissection to prevent later confusion. The Hemo-o-lok® polymer clips (Teleflex, Limerick, PA) are useful to bundle the sutures together for later manipulation and prevent distraction during the rest of the procedure. Our initial intracorporeal diversions were primarily aimed at female patients as it avoided an otherwise necessary abdominal incision for specimen extraction (generally extracted through the vagina). However, independent of the type of diversion we would recommend making the incision, if needed, that best provides the surgical team with the best exposure need to quickly complete the operation, which in most cases does not coincide with existing trocar placement.

The Learning Curve: Are We There Yet?

The concept of a learning curve is based upon the premise that practice makes perfect. In urology, a number of studies have evaluated the learning curve regarding robot-assisted radical prostatectomy [12–14]. In general, these studies demonstrate improvements in the margin negative rate, blood loss, and operative time in the first 40–50 cases with a more gradual improvement after that time. It is important to accurately reflect on patient outcomes and experiences to improve surgical training, enhance hospital credentialing, and reassure patients.

However, identification of a learning curve associated with robot-assisted radical cystectomy has been elusive due to the many factors that individually can influence this parameter. Indeed, some authors have questioned whether such a learning curve exists given that surgeons performing bladder cancer surgery are generally well-trained surgeons prior to embarking on the procedure for bladder cancer. Thus far, studies have focused efforts to characterize the learning curve based upon several early postoperative parameters including blood loss, lymph node yield, operative time, surgical margin status, and early complications [7, 15–17]. While most of these studies have demonstrated an improvement with time, it is clear that if a learning curve exists, it is different for each surgeon (Table 3.2). Furthermore, techniques for these procedures are constantly evolving and even providers considered to be experts in robot-assisted bladder surgery are continually searching for mechanisms and methods to simplify and improve the procedure. We have found that the learning curve can be dramatically shortened building on personal experience not only with robot-assisted and prior pelvic surgery, but with video review as well. Not everyone has the luxury of an in-house mentor who is already expert at these procedures. We have discovered that reviewing the successful procedures of others and learning from them is critical to adoption. Additionally we routinely record all our procedures then review them to see what we liked and did not like about the procedure and what we would change. We found that this exercise in reflection with the advantage of the pathology report has helped us to improve our technique and disease outcomes. If there are several surgeons, both open and robot assisted, available, the exchange of ideas and criticism can further push everyone to maximize their surgical outcomes.

Table 3.2 Factors impacting length of learning curve

Prior robotic surgical experience
Mentoring of initial robotic cystectomy cases
Patient factors (tumor extent, BMI, prior surgeries, pelvic irradiation, etc.)
Robotic set-up time
Type of urinary diversion
Experience of robotic team
Self evaluation

Outcome Measurement: How Are We Doing?

A commitment to robot-assisted bladder cancer surgery must be continually critical of perioperative and postoperative outcomes. While we continue to await data from randomized trials, robot-assisted radical cystectomy will continue to be scrutinized. Therefore, it is essential for surgeons to be aware of how they are doing relative to their own experience and the only way to do so is to continually monitor outcomes. The development of a prospectively maintained database should be created prior to the completion of the first procedure and is an important aspect of beginning the practice. Preoperative, intraoperative, and postoperative data are collected from all patients undergoing robot-assisted bladder surgery at our institution. Fundamental components of this data collection include patient demographics, clinical tumor characteristics, comorbidities, neoadjuvant chemotherapy, operative time, blood loss, pathologic characteristics (including positive margins), and hospital stay (Table 3.3). Although such collection can be time consuming, it is important to continually reflect upon one's outcome in order to improve with time. It is impossible to experience

Table 3.3 Necessary elements for database collection

Preoperative components
Age
Sex
Clinical stage
BMI
Neoadjuvant therapies
Surgical components
Estimated blood loss
Operative time (separate for node dissection, cystectomy, and urinary diversion)
Type of urinary diversion
Intraoperative complications
Pathologic stage
Surgical margin status
Nodal yield
Postoperative components
Length of hospital stay
Postoperative complications (including Clavien classification)
Disease recurrence and location

a "learning curve" if one is not aware of their outcomes.

Final Thoughts

Getting started is frequently the most difficult portion of adopting any new procedure or technology. Establishment of a robust robot-assisted surgical program requires commitment from hospital administration (for console time), surgeons, anesthesiology, and the development of a robotic team. Adequate preparation, patient selection, equipment availability, and dedication of the whole team, however, can make the difference between a successful experience and one that flounders. As surgeons, we owe it to our patients to make the procedure as safe and efficacious as possible.

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