Current Urology Reports (2019) 20: 7
https://doi.org/10.1007/s11934-019-0873-9

SURGERY (J SIMHAN, SECTION EDITOR)

Penile Implant Considerations in the Bladder Cancer Survivor

Jeffrey C. Loh-Doyle[1]

Published online: 28 January 2019
© Springer Science+Business Media, LLC, part of Springer Nature 2019

Abstract

Purpose of Review After radical cystoprostatectomy, patients often develop erectile dysfunction refractory to first- and second-line treatments. In this review, we summarize and analyze the literature describing the technical considerations and outcomes of penile implant surgery in bladder cancer patients with history of radical cystectomy and urinary diversion.

Recent Findings Penile prosthesis surgery in patients after radical cystectomy and urinary diversion has been infrequently described in the literature. Recent studies have shown that the three-piece inflatable penile prosthesis can be placed safely after significant prior intraabdominal surgery due to the development and refinement of several techniques to place the reservoir. Further studies are needed to objectively determine the impact of penile prosthetic surgery on functional outcomes in this historically undertreated yet increasingly significant patient population.

Summary As health-related quality of life outcomes continue to gain increasing importance after radical cystectomy, urologists should offer motivated bladder cancer survivors the inflatable penile prosthesis as the treatment of choice for refractory erectile dysfunction due to its safety and unmatched ability to restore erectile function.

Keywords Cystectomy · Erectile dysfunction · Penile prosthesis · Urinary diversion · Bladder cancer · Quality of life · Survivorship

Introduction

After extirpative treatment for bladder carcinoma, many patients will develop erectile dysfunction (ED) refractory to conservative treatment options [1, 2]. In those patients, penile prosthetic surgery has long been considered the gold-standard treatment option.

Due to improvements in overall survival, health-related quality of life outcomes such as ED have gained increasing importance in the comprehensive treatment of patients with bladder cancer [3]. Despite this, penile prosthetics continue to be underutilized and seldom described in this unique but prevalent patient population [4]. Considering this deficiency, we review the contemporary literature and share our own clinical experience over the past 30 years treating erectile dysfunction after radical cystoprostatectomy (RC) and urinary diversion.

This article is part of the Topical Collection on *Surgery*

✉ Jeffrey C. Loh-Doyle
jeffrey.loh-doyle@med.usc.edu

[1] Institute of Urology, USC/Norris Comprehensive Cancer Center, University of Southern California, 1441 Eastlake Avenue, Suite 7416, Los Angeles, CA 90089-9178, USA

Materials and Methods

We performed a PubMed literature search to obtain all peer-reviewed articles published in English describing technique and outcomes of penile implants in patients with bladder carcinoma as well as contemporary articles describing outcomes of penile implants in patients with significant abdominal surgery or fibrosis. Lastly, we also reviewed our own clinical experience over the past 3 decades.

Patient Selection, Preoperative Counseling, and Perioperative Care

After RC, ED should be identified and treated purposefully. Providers should discuss all available treatment options, including definitive prosthetic repair and start patients on customized treatment pathways that take into account patient goals and anticipated response to therapy. Patients with mild to moderate ED are offered first- and second-line treatment options including oral 5-phosphodiesterase inhibitors, intracavernosal vasoactive medications, and the vacuum erection device. In our experience, response to medication tends to be variable in this patient population and is

dependent on several patient specific factors including age, comorbid conditions, preoperative erectile function, and history of nerve-sparing RC. In subsequent follow-up, patients are closely monitored for treatment success after initiating therapy. The inflatable penile prosthesis (IPP) is offered to patients who fail to respond to medications or to those who desire upfront definitive repair.

During consultation, risks of device implantation including infection, mechanical failure, and injury to adjacent structures, including urinary diversion, is included in preoperative counseling and consent. A careful review of the patient's surgical history, including details of the RC such as surgical approach (robotic versus open), type of urinary diversion, stoma location, and location of diversion bowel segment is essential to minimize the risk of intraoperative and reservoir-related complications.

Before surgery, providers should adhere to institutional and implanter specific preoperative protocols. On the day of surgery, irrigation of continent diversion, hair removal, and isolation of the stoma using sterile dressings is performed prior to skin preparation and incision. Patients are given broad spectrum intravenous antibiotics for prophylaxis depending on surgeon preference and based on regional antibiograms. A closed suction drain is placed in all patients and removed on postoperative day one. Overnight catheter drainage is used in patients with neobladder and continent cutaneous urinary diversion.

Implant Selection

While there is a role and indication for each type of penile implant, we feel that in the bladder cancer survivor, the three-piece inflatable device is the ideal choice. Nevertheless, we acknowledge the role of other devices in patients with history of significant intraabdominopelvic surgery and briefly review the experiences of others using semi-rigid and two-piece inflatable devices.

The Semi-Rigid (Malleable) Prosthesis

In the modern era, the role of the semi-rigid implant is limited and should be used in select situations such as salvage procedures, patients with significantly limited manual dexterity, or when inflatable devices are not available due to geographical or economic constraints [5, 6]. Although these devices can be placed easily with a very low risk of infectious complications or injury to adjacent structures, they are limited by lack of rigidity and flaccidity, limited functionality, and the long-term potential for erosion of the cylinder. A review of the contemporary literature found only one series describing outcomes of semi-rigid devices after primary placement in patients after treatment for genitourinary malignancy [7]. We feel that this paucity of data is consistent with the overall decline in the use of this implant as a primary device when inflatable devices are available as shown in several statewide and national analyses of penile prosthesis utilization [8, 9]. In regions where inflatable devices are not available, there is undoubtedly a continued role for malleable penile implants.

Two-Piece Inflatable Penile Prosthesis

Despite low rates of mechanical failure and high patient satisfaction, the two-piece inflatable device now represents a small fraction of devices being implanted [10]. During development, the objective was to produce a device that could simplify implantation and overcome the challenges and danger of blind reservoir placement in patients with history of pelvic/abdominal anatomy by combining the reservoir and cylinders into a single self-contained unit. After its introduction, implanters began to realize that the two-piece design was prone to disadvantages including auto inflation, spontaneous deflation, lack of rigidity, and the need for longer corporotomies when compared to three-piece devices [10, 11]. Despite this, the two-piece device has demonstrated favorable outcomes and high satisfaction rates as nicely summarized by two recently published reviews [10, 11]. These studies also included discussions of the ideal surgical candidate for two-piece devices which included patients with solid organ transplants, limited dexterity, as well as those with history of RC and urinary diversion.

While the two-piece device has proven itself as a reliable and effective treatment for ED, many high-volume implanters have abandoned this device in favor of placing three-piece inflatable implants due to several safe and reproducible techniques for alternative reservoir placement in patients with challenging anatomy including those who have undergone RC. While a randomized trial comparing outcomes of two-piece and three-piece devices could identify differences between outcomes, complications, device survival, and satisfaction, it has been our experience, and the experience of others in the field, that the three-piece device is superior to its two-piece counterpart in its ability to restore dynamic penile function and is the implant of choice in patients after RC and urinary diversion. Nevertheless, the two-piece remains an attractive choice for implanters who have less experience with ectopic reservoir placement techniques.

Three-Piece Inflatable Penile Prosthesis

The three-piece IPP has long been considered the gold-standard treatment option for medication refractory ED. Despite this, population-based studies suggest that the IPP is rarely offered to patients after RC despite high rates of ED [4]. This disparity is due in large part to the assumed challenge of reservoir placement due to significant postsurgical fibrosis and potential for injury to urinary diversion, a concern

reinforced by small case reports describing injury and erosion of reservoirs into urinary diversion [12–14]. Fortunately, recent studies have dispelled these assumptions and shown that three-piece devices and prosthetic balloons can be placed safely in patients with history of significant abdominal and pelvic surgery, including those patients that have undergone solid-organ transplantation, pelvic radiation, and RC and urinary diversion [15–17].

Based on the findings of these studies, as well as those describing alternative reservoir placement, three-piece inflatable penile implants should be offered as the implant-of-choice to patients that desire reliable restoration of erectile function. In the subsequent sections, we discuss nuances of surgical technique and our personal experience with outcomes of these devices in bladder cancer survivors.

Surgical Approach: Infrapubic Versus Penoscrotal

While it has been our preference to utilize the infrapubic approach, IPP implantation should proceed through the approach that the operating surgeon is accustomed to. As Palmisano et al. nicely presented in their review of both approaches, the infrafubic and penoscrotal approaches are safe, effective, and result in high rates of patient satisfaction [18]. While studies have shown the merits of each approach, surgeons should be well-versed in both incisions if unexpected challenges are encountered.

We feel that the infrafubic approach is particularly advantageous in patients with NB and urinary incontinence who either have an artificial urinary sphincter (AUS) or are considering one. When the IPP is placed through an infrafubic incision and dilation is done as close to the dorsal aspect of the tunica albuginea as possible, we believe that that there is more of a cushion of corpora cavernosa between the urethral cuff and the penile prosthesis which may reduce the compression of the urethra when both devices are present. This hypothesis is supported by our long-term institutional data which showed no increase rate of AUS complications in patients with history of RC and urinary diversion when both devices were placed [19].

Reservoir Placement: Considerations and Complications

After RC, reservoir placement in the Space of Retzius (SOR) can be challenging due to significant fibrosis, adhesions, possible translocation of bowel, and urinary diversion in this space. As such, reservoirs should be placed in an alternative location based on a familiarity with different surgical approaches for RC and urinary diversion and implanter preference. Several techniques and locations have been described in patients with history of major abdominal surgery which are supported by studies that show minimal complications after long term follow-up as discussed below.

Over the last 35 years, our standard location for prosthetic reservoirs in patients after radical pelvic surgery has been the lateral retroperitoneum accessed through a counter-incision medial to the iliac crest as shown previously from our institution [14]. This technique is analogous to that of a Gibson incision, an approach to the extra peritoneal space familiar to many urologists. During that time, there have been minimal complications related to adjacent organ injury, no instances of reservoir erosion into adjacent intestinal or vascular structures, no complaints of a visible or palpable bulge from the reservoir, and no cases of tubing entanglement causing device malfunction. This location was also studied by Hartman et al. who describe a similar encouraging experience [20]. Laterality of reservoir placement is primarily dependent on diversion type. In patients with orthotopic neobladder urinary diversion, the reservoir can be placed safely in the right or left retroperitoneal space. In patients with continent cutaneous urinary diversion or ileal conduit, our preference is to place the reservoir in the space contralateral to the stoma (typically in the left lateral retroperitoneum). This space also has the added benefit of allowing for easy interrogation of the reservoir in the event that removal or revision is required. A contemporary comprehensive analysis of over 1000 cases of this technique is in preparation.

While our preference has been to utilize the lateral retroperitoneum, we also acknowledge the success of others who have described alternate techniques and locations for reservoir placement in patients with history of RC and urinary diversion. Kim et al. recently presented a case report describing their technique for preperitoneal IPP reservoir placement accessed through an incision made lateral to the umbilicus in a patient with orthotopic continent diversion [21]. Interestingly, Cappocia et al. recently described their experience, which included 3 patients with history of RC, using the "modified Jorgenson scissors technique" to place reservoirs in the SOR despite prior pelvic surgery [22]. While these techniques are certainly feasible and undoubtedly effective, the ectopic location that is most broadly used is submuscular placement in which reservoirs are placed in the anatomic space between the rectus abdominis and transversalis muscle [23•, 24•]. In order to minimize a visible and palpable bulge, both prosthetic manufacturers introduced low profile reservoirs. Despite the widespread adoption of various forms of this technique and excellent functional outcomes, only a small number of patients with prior cystectomy were included in available case series. As such, studies of reservoir placement anterior to the transversalis fascia in patients after RC are limited and further study in this specific subset of patients is needed to better appreciate outcomes in patients postcystectomy. This is particularly relevant in light of the recent multicenter study from Hernandez et al. which reported on complications of alternative reservoir placement which include fluid leak, reservoir-induced abdominal pain, reservoir tubing torsion, and a palpable bulge [25].

A fundamental component of successful prosthetic implantation is consistency and confidence and, as such, implanters should choose a strategy for reservoir placement that they are most comfortable performing and have had previous success with.

Artificial Urinary Sphincter: Safe to Combine?

Both devices can be safely implanted in patients with ED and bothersome urinary incontinence after orthotopic continent urinary diversion without an increased risk of infectious or mechanical complications. As other experts have discussed, there is no doubt that the penile prosthesis can impact the vascularity of the urethra so patient selection and counseling is key to minimize the risk of erosive complications [26]. In patients in whom an AUS is already present, proximal corporal dilation should be done carefully and with the expectation of encountering a step-off once the cuff is encountered.

In reviewing our contemporary experience of patients with both the AUS and IPP, 39 patients with history of RC and NB were identified. When compared to an appropriately matched control group of patients, patients with history of bladder cancer and orthotopic neobladder were not found to be at increased risk for device complications including erosion of the AUS. While our study did not specifically include patients who underwent transcorporal cuff placement, our anecdotal experience has shown that corporal cylinders are not encountered during dissection for transcorporal cuff implantation when the penile implant was placed through an infrapubic incision.

Patient Satisfaction and Effects on Body Image Perception

The IPP has been shown to have excellent rates of patient and partner satisfaction [27, 28]. While no studies exist that show objective functional outcomes in bladder cancer patients, our own experience suggests that the three-piece IPP effectively restores sexual function and results in objective improvements in erectile function based on postprocedure evaluation using validated questionnaires (IIEF-5). In addition to functional recovery, many patients have found that the prosthesis seemed to undo the loss in penile length they perceived after RC and improved body image perception. While we are encouraged by these commonly held individual experiences, future studies are needed to validate these findings.

Conclusions

Historically, ED after treatment for invasive bladder cancer has been underdiagnosed and poorly treated. As a result, penile implant surgery has been underutilized in bladder cancer survivors. After successful treatment for bladder cancer, motivated patients should be offered the three-piece IPP as the treatment of choice for refractory erectile dysfunction due to its safety and unmatched ability to restore erectile function.

Compliance with Ethical Standards

Conflict of Interest Jeffrey C. Loh-Doyle declares no potential conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Allareddy V, Kennedy J, West MM, Konety BR. Quality of life in long-term survivors of bladder cancer. Cancer. 2006;106:2355–62.
2. Modh RA, Mulhall JP, Gilbert SM. Sexual dysfunction after cystectomy and urinary diversion. Nat Rev Urol. 2014;11:445–53.
3. Mohamed NE, Herrera PC, Hudson S, et al. Muscle invasive bladder cancer: examining survivor burden and unmet needs. J Urol. 2014;191:48–53.
4. Chappidi MR, Kates M, Sopko NA, Joice GA, Tosoian JJ, Pierorazio PM, et al. Erectile dysfunction treatment following radical cystoprostatectomy: analysis of a nationwide insurance claims database. J Sex Med. 2017;14:810–7.
5. Habous M. Malleable (semi-rigid) penile prosthesis (MPP). J Sex Med. 2015;12:1984–8.
6. Gross MS, Phillips EA, Balen A, Eid JF, Yang C, Simon R, et al. The malleable implant salvage technique: infectioun outcomes after Mulcahy salvage procedure and replacement of infected penile prosthesis with malleable prosthesis. J Urol. 2016;195:694–7.
7. Sevinc C, Ozkaptan O, Balaban M, Yucetas U, Karadeniz T. Outcome of penile prosthesis implantation: are malleable prosthesis an appropriate treatment option in patients with erectile dysfunction caused by prior radical surgery. Asian J Androl. 2017;19:477–81.
8. Kashanian JA, Golan R, Sun T, Patel NA, Lipsky MJ, Stahl PJ, et al. Trends in penile prosthetics: influence of patient demographics, surgeon volume, and hospital volume on type of penile prosthesis inserted in New York state. J Sex Med. 2018;15:245–50.
9. Mirheydar HS, Palazzi KL, Parsons K, et al. Hospital-based trends in penile prosthetic surgery. J Sex Med. 2015;12:1092–8.
10. Abdelsayed GA, Levine LA. Ambicor 2-piece inflatable penile prosthesis: who and how? J Sex Med. 2018;15:410–5.
11. Ko OK, Bennett NE. Ambicor two-piece inflatable penile prosthesis: background and contemporary outcomes. Sex Med Rev. 2018;6:319–27.
12. Godiwalla SY, Beres J, Jacobs SC. Erosion of an inflatable penile prosthesis reservoir into an ileal conduit. J Urol. 1986;137:297–8.
13. Tran CN, Boncher N, Montague DK, Angermeier KW. Erosion of inflatable penile prosthesis reservoir into neobladder. J Sex Med. 2013;10:2343–6.

14. Hudak SJ, Mora RV. Unilateral ureteral obstruction due to a migrated inflatable penile prosthesis reservoir. J Urol. 2008;180:336.
15. Sun AT, Babbar P, Gill BC, et al. Penile prosthesis in solid organ transplant recipients – a matched cohort study. Urology. 2018;117:86–8.
16. Loh-Doyle J, Patil MB, Nakhoda Z, Nassiri N, Yip W, Wayne K, et al. Three-piece inflatable penile prosthesis placement following pelvic radiation: technical considerations and contemporary outcomes. J Sex Med. 2018;15:1049–54.
17.•• Loh-Doyle J, Patil MB, Sawkar H, et al. 3-piece inflatable penile prosthesis placement following radical cystoprostatecomy and urinary diversion: technique and outcomes. J Sex Med. 2018;15:907–13 **This study describes technique and long-term outcomes of the three-piece inflatable device in patients that have undergone radical cystectomy and urinary diversion. Its strengths include its large sample size and clear description of ectopic reservoir placement in patients with urinary diversion.**
18. Palmisano R, Boeri L, Cristini C, et al. Comparison of Infrapubic vs Penoscrotal approaches for 3-piece inflatable penile prosthesis placement: do we have a winner? Sex Med Rev. 2018;6:631–9.
19. Loh-Doyle J, Ashrafi A, Nazemi A, et al. Dual Prosthetic Implantation After Radical Cystoprostatectomy and Neobladder: Outcomes of the Inflatable Penile Prosthesis and Artificial Urinary Sphincter in Bladder Cancer Survivors Urology. 2019.
20. Hartman RJ, Helfand BT, McVary KT. Outcomes of lateral retroperitoneal reservoir placement of three-piece penile prosthesis in patients following radical prostatectomy. Int J Impot Res. 2010;22:279–83.
21. Kim JK, Cho MC, Ku JH, Paick JS. Preperitoneal placement of an inflatable penile prosthesis reservoir for postoperative erectile dysfunction after radical cystoprostatectomy with orthotopic neobladder. Investig Clin Urol. 2016;57:364–6.
22. Cappocia E, Phelps J, Levine LA. Modified inflatable penile prosthesis reservoir placement into space of Retzius: comparing outcomes in men with or without prior pelvic surgery. J Sex Med. 2017;14:968–73.
23.• Stember DS, Garber BB, Perito PE. Outcomes of abdominal wall reservoir placement in inflatable penile prosthesis implantation: a safe and efficacious alternative to the space of Retzius. J Sex Med. 2014;11:605–12 **This study describes an easily reproducible and effective way of placing penile implant reservoirs in patients with history of intraabdominal surgery.**
24.• Morey AF, Cefalu CA, Hudak SJ. High submuscular placement of urologic prosthetic balloons and reservoirs via transscrotal approach. J Sex Med. 2013;10:603–10 **This study describes an easily reproducible and effective way of placing penile implant reservoirs in patients with history of intraabdominal surgery.**
25. Clavell Hernandez J, Trost L, Kohler T, et al. Emerging complications following alternative reservoir placement during inflatable penile prosthesis placement: a 5-year multi institutional experience. J Urol. 2018;199.
26. Sundaram V, Cordon BH, Hofer MD, Morey AF. Is risk of artificial urethral sphincter cuff erosion higher in patients with penile prosthesis? J Sex Med. 2016;13:1432–7.
27. Montorsi F, Rigatti P, Carmignani G, Corbu C, Campo B, Ordesi G, et al. AMS three-piece inflatable implants for erectile dysfunction: a long-term multi-institutional study in 200 consecutive patients. Eur Urol. 2000;37:50–5.
28. Bernal RM, Henry GD. Contemporary patient satisfaction rates for three-piece inflatable penile prostheses. Adv Urol 2012;707321:1–5, 2012.