Exenterative Surgery for Advanced Prostate Cancer

Michael E. Kelly · Danielle Courtney ·
Greg J. Nason · Des C. Winter

Published online: 23 August 2014
© Springer Science + Business Media New York 2014

Abstract The incidence of locally advanced prostate cancer has decreased in the last few decades since the introduction of screening programmes. Despite earlier detection and treatment, there is still a proportion of late presentation and/or recurrences (around 10 %) of locally advanced prostate cancer. Additionally, sporadic reports of synchronous pelvic neoplasms have been published with various treatment strategies to optimize patient survival. Pelvic exenteration is a technically demanding surgical procedure that is performed for locally advanced, recurrent or synchronous pelvic malignancies. The role of pelvic exenteration in locally advanced prostate cancer has been controversial, as there is a lack of strong statistical evidence to support its role. Despite this, studies have outlined benefits of this procedure, especially in the presence of synchronous pelvic cancers or for palliative indications. Despite advances in surgical care and techniques, pelvic exenteration remains a high-risk procedure with troublesome complications. However, with better patient selection, multi-disciplinary team (tumour board) involvement and surgery being performed in specialist high volumes centres, rates of morbidity and mortality have substantially reduced.

Keywords Pelvic exenteration · Advanced pelvic neoplasm · Prostate cancer · Recurrent prostate cancer · Surgical outcomes · Surgical complications

Introduction

Pelvic exenteration is a technically challenging procedure that is commonly performed for locally advanced or recurrent pelvic malignancies [1]. Commonly resected neoplasms include cervical, endometrial, vulval, vaginal, bladder, colorectal or pelvic sarcomas [2•, 3]. Additionally, resection of locally advanced prostate cancer has been reported [2•]. Classical total pelvic exenteration involves the extirpation of the anal canal, rectum and distal colon. Additionally, the bladder, lower ureters, reproductive organs, adjacent lymph nodes and peritoneum are removed en bloc [2•, 3, 4]. With the removal of the bladder, urinary diversion is required, either by ileal conduit or forming a wet colostomy or neobladder [2•, 5].

In the modern era of surgery, organ preservation and minimally invasive surgery have been largely in the spotlight. Despite this, the role of pelvic exenteration remains an important surgical treatment modality in appropriately selected cases of advanced pelvic neoplasms [1]. With improved surgical and oncological techniques and treatments, many advanced pelvic malignancies are still amenable to curative resection [2•, 6]. Additionally, the outcomes of locally advanced pelvic malignancies are dismal, when left untreated, with many patients having severe progression of pelvic pain [7].

Pelvic exenteration was first described by Brunschwig in 1948 as a palliative procedure for locally advanced gynaecological cancers [8]. However, the focus of the operation shifted towards a curative procedure in later years [1]. Although Brunschwig described the procedure as being a “brutal and cruel” surgery, he believed it saved lives [8]. Throughout the 20th century, its role has been controversial and debated. In the 1960’s, it was considered an outdated procedure with little oncological benefit, only

This article is part of the Topical collection on *Prostate Surgery and Related Procedures*.

M. E. Kelly (✉) · D. Courtney · G. J. Nason · D. C. Winter
Department of Surgery, St Vincent’s University Hospital,
Elm Park, Dublin, Ireland
e-mail: Kellym11@tcd.ie

serving to cause patients further disfigurement and pain [9]. Despite this, modifications of surgical techniques allowing for better oncological resections coupled with improved reconstruction techniques have led to a revival of pelvic exenteration. Furthermore, improved chemoradiotherapy regimens and better patient selection have re-established it as an important treatment option in management of advanced pelvic neoplasm [9, 10].

Historically, the rates of morbidity and mortality post-operatively were substantially high [11, 12]. Early series reported mortality rates of up to 30 % [13–15]. However, contemporary studies observe mortality rates well below 5 % in specialist centres [16–19]. This has been largely attributable to better patient selection coupled with improved anaesthetic/perioperative management which has significantly reduced morbidities also [2, 20]. The reduction in morbidity and mortality has also been a “key” factor in its revival as an oncological and palliative procedure.

Prostate Cancer—Locally Advanced Disease

Prostate cancer is the second most common cause of cancer-related deaths in males [21]. Its incidence has increased over the last few decades [22, 23]. In Europe, it is the most common solid neoplasm, with an incidence of 214 per 1,000 men, outnumbering colorectal and pulmonary cancer [21]. The development of screening for prostate cancer, albeit without dedicated screening programmes, with prostate-specific antigen (PSA) has resulted in earlier detection and treatment of prostate cancer at earlier stages [24]. Despite this, patients still present or develop locally advanced prostate cancer with concomitant complications [25]. Additionally, studies have observed that as high as 10 % of patients receiving primary radiation therapy develop a symptomatic local recurrence [26]. The sequelae of locally advanced disease can be serious including severe haematuria, relentless pelvic pain, bowel obstruction or urinary obstruction with obstructive uropathy [26].

The treatment of prostate cancer is guided by risk stratification. Parameters including PSA, Gleason score and patient co-morbidity index together dictate which treatment approach is the best [22]. However, the management of locally advanced prostate cancer is still debated [27•]. Options include radical options in the form of radical prostatectomy or radical radiotherapy with or without adjuvant hormonal manipulation, hormonal treatment alone or a watchful waiting approach. In the past, radical prostatectomy (RP) was only deemed suitable in those patients without extra-prostatic involvement. However, in recent years with improved RP techniques, it has been used selectively in patients with locally advanced prostate

cancer (cT3 disease), though long-term survival results remain variable [27•]. Alternatively, external-beam radiotherapy combined with androgen-deprivation therapy has become the most widely accepted treatment approach of choice [28]. The role of radiation therapy for the treatment of prostate cancer was introduced in 1915 [29]. Its popularity substantially increased in the 1980's with the development of the linear accelerator. In recent times, improvements including three-dimensional conformal radiotherapy and brachytherapy have positioned it as the main treatment choice for local advanced disease [29].

Additionally, palliative procedures are an important part of the armament in the management of locally advanced prostate cancer. Palliative transurethral resection of the prostate (TURP) has been used for several decades as treatment option for obstructive outflow symptoms. However, concerns regarding the possibility that its use contributes to metastatic spread due to tumour spillage and haematological dissemination has been raised [30]. Alternatively, laser vaporization of the prostate using a potassium titanyl phosphate laser has also been advocated with promising results [25]. However, none of these treatment approaches alleviate the debilitating pelvic pain that can be caused by local recurrence. This complication is notoriously difficult to treat, requiring a multi-modality approach including pain specialist input. Exenterative surgery has been noted to have an important role in helping to ameliorate symptoms [25].

Exenterative Surgery for Advanced Prostate Cancer

Advanced prostate cancer may spread locally to adjacent organs including the seminal vesicles, bladder and less commonly to the rectum [31]. The role of exenterative surgery in advanced prostate cancer has been controversial and debated in recent years. Good surgical and anatomical knowledge is extremely important prior to perform pelvic exenteration. Additionally, high-quality imaging is required to establish the tumour anatomy and/or recurrence pattern to minimize associated morbidity [11]. Surgeons must be acquainted with several surgical techniques including pelvic and urological reconstructive options to tailor the surgery to each patient [11].

The primary goal of pelvic exenterative surgery is to provide patients the optimal chance of survival, while bestowing a reasonable quality of life [32]. Zincke in 1992 reported the largest series to date of exenterative surgery versus radical prostatectomy for the management of recurrent locally advanced prostate cancer after radiotherapy (32 anterior and 23 total pelvic exenterations). He observed that the exenteration group had no improvement in local control. Furthermore, there was no statistical

survival benefit, with higher complications rate post-operatively when compared to radical prostatectomy group [33]. In modern times, the procedure still remains a high-risk surgery, despite perioperative advancements and better patient selection. As a result, many surgeons advocate that it should only be indicated for those patients in whom long-term survival is plausible [1, 11].

To date, the majority of literature published on pelvic exenterative surgery for prostate cancer is either focused on recurrent locally invasive prostate cancer or prostate cancer with other synchronous rectal cancer. However, the role of exenterative surgery in the management of severe pelvic pain that is refractory to medical therapies has also emerged as an important treatment modality [34, 35, 36••].

Exenterative Surgery for Synchronous Prostate and Rectal Cancer

The co-existence of synchronous prostate and pelvic neoplasms has been reported sporadically across the literature, with the majority confined to mainly case reports and small case series making the evidence weak. Furthermore, there are substantial variations in neoadjuvant regimens, with varying management approaches and survival outcomes.

Prostate and rectal cancers account for the most common pelvic cancers among the male population [37]. They can occur both metachronously or synchronously. There is suggestion that the two cancers may share a common aetiology [37]. The management of synchronous prostate and rectal cancer is challenging, due to the complex anatomy of the pelvis and the significant impact that surgical treatment can have on the patient's quality of life [38]. With improved life expectancies, the incidence of concurrent prostate and rectal cancers is likely to increase, and its management strategies will become more relevant. Kavanagh et al. outlined very relevant points regarding the difficulties in the management of synchronous rectal and prostate cancer, with the need for good pre-operative planning [39••]. The role of neoadjuvant chemoradiotherapy in treating locally advanced rectal cancer has become well established in recent years [40, 41]. Patients either receive a short neoadjuvant therapy course involving 25 Gy over 1-week, with surgery approximately 2 weeks later. Or alternatively, they receive a longer neoadjuvant therapy course with 50 Gy over a 5-week period and surgery usually 8 weeks post treatment [39]. Regardless of the method, neither regimen is adequate for the appropriate treatment of locally advanced prostate cancer. The difference in radiation dosage for prostate and rectal cancer poses a substantial treatment challenge. The radiation dose for appropriately managing rectal cancer is sub-therapeutic for the treatment of prostate cancer. Moreover, the higher

radiation dose for prostate cancer would render a low anterior resection to be extremely difficult, with a higher risk of breaching the prostatic capsule or perforating the rectum. Additionally, the risk of gastrointestinal anastomotic leak post-operatively would also be increased with the higher radiation dose [39••]. It is in this setting of synchronous neoplasms that pelvic exenteration is thought to be more applicable (even though it too carries a significant post-operative morbidity risk). Alternatively, the concept of watchful waiting after chemoradiotherapy in rectal cancer with good clinical follow-up and repeat biopsies is gaining momentum [39••]. This strategy of thorough clinical surveillance of the rectum with hormonal therapy for prostate is becoming popular. Salvage pelvic exenteration is therefore still available if recurrence or persistent disease is present.

Seretis et al's. [38] review of the literature found three case reports and five case series that reported a total of twenty-three synchronous prostate and rectal neoplasms. They also highlighted the need for thorough pre-operative planning involving both urological and colorectal multidisciplinary (tumour board) meetings to balance between good oncological surgery and preservation of patient's function [38].

Exenterative Surgery for Palliative Management of Prostate Cancer

Locally advanced or recurrent prostate cancer can be a debilitating and devastating disease. The associated perineal pain is notoriously difficult to palliate by conventional methods [25]. This pain is attributable to local invasion of tumour into the sacrum or rectum [25]. Initially, patients receive a combination of hormonal therapy, radiation treatment and analgesia. Referral to pain specialist is also beneficial [25]. When these avenues have been exhausted, pelvic exenteration may be considered for palliative reasons, not as a curative procedure [25]. Several studies have reported pelvic exenteration as an effective therapy for palliative treatment of locally advanced prostate cancer pain, which is refractory to medical therapies [42, 43]. Additionally, it can also mitigate other local symptoms and complications of advanced disease including persistent haematuria, urethral obstruction, rectal incontinence and voiding dysfunction [42, 44].

Kamat et al. [42] reported their experience of fourteen patients who underwent total pelvic exenteration for locally advanced prostate cancer causing substantial pelvic pain refractory to pharmacological treatments. All patients had significant pain relief post-operatively, with eleven (79 %) having complete relief of pain symptoms. Additionally, the mean symptom-free period after surgery was 14.1 months.

Despite this, half of patients developed a post-operative morbidity including wound issues, deep abdominal collection, ileus and pulmonary embolus [42]. This highlighted that the procedure is highly valuable, but risk of morbidity is high and, therefore, patient selection is crucial for good outcomes.

Leibovici et al. [43] also reported the role of palliative debulking as a means to gain pain control. In their series, total pelvic exenteration was carried out on four patients, all which had recurrence of the prostate cancer following radical prostatectomy and radiotherapy [43]. All four were permanently relieved of local symptoms following surgery. However, one patient did have an entero-urethral fistula post-operatively [43]. They also concluded that salvage exenteration surgery is feasible and provides effective palliation in patients with bulky local recurrence following RP [43]. Other options for local recurrence include salvage radical prostatectomy and cystoprostatectomy. However, extensive surgical resection (exenterative surgery) has been shown to be of benefit for symptomatic local recurrence of pelvic neoplasms with adjacent organ invasion [29, 43, 45].

Exenterative Surgery Complications

Despite the advancements in surgical care and techniques, pelvic exenteration remains a formidable procedure with high-risked complications that can be troublesome [1]. Initial reported mortality rates have dramatically improved from greater than 30 % mortality to rates between <10 % [2]. Improvements over the last 60 years have been multifactorial including improved surgical care, centralization of services, better radiological imaging, neoadjuvant chemoradiation regimens and improved perioperative care [2]. The incidence of post-operative morbidities has significantly improved also, though its rates have been variable across several series 30–84 % [11].

Kakuda et al. [46] observed a re-admission rate of 45 %, with 32 % of patients requiring additional surgery. Common complications include wound problems, deep abdominal abscess formation, collections and bowel obstructions (Table 1). Early complications (around 10 % of patients) are usually due to urinary or enteric anastomosis issues [47]. Most leaks are managed conservatively with prolonged conduit drainage. Alternatively, diversion of urine via percutaneous nephrostomy tubes may be required [11]. Later complications are usually due to fistulas or stenosis, which are challenging and troublesome [11]. These have been reported in up to 16 % of patients [48]. Evidence shows a clear correlation between prior radiation exposure and fistula/stenosis formation post exenterative surgery [11]. Jakowatz et al. [49] observed that

Table 1 Complications associated with pelvic exenteration surgery

General
Bleeding
Wound infection
Lower respiratory infection/pneumonia
Deep venous thrombosis/pulmonary embolism
Stoma care issues
Gastrointestinal
Bleeding
Anastomotic leak/Abdominal collection
Obstruction/Adhesions
Enteroperineal fistulation
Parastomal hernia
Urinary
Urinary conduit leak
Anastomotic stricture
Urosepsis
Pelvis
Pelvic abscess/fistula
Reconstruction issues
Flap necrosis/break-down

67 % of patients who underwent prior radiotherapy had a post-operative complication, compared to 26 % with no prior radiation exposure. Additionally, Goldberg et al. observed high levels of enteric and ureteral anastomotic fistula rates in those patients who had mesh and other foreign materials for pelvic floor reconstruction compared with myocutaneous grafts [50].

Conclusion

The technique of pelvic exenteration though introduced as a palliative procedure has a role in the treatment of locally advanced tumours, whereby complete resection offers the only possibility for cure. Pelvic exenteration with its numerous modifications remains an important treatment option for both curative and palliative reasons for patients presenting with advanced or recurrent pelvic malignancies. Improvements in surgical techniques and perioperative care have significantly reduced associated morbidity with this procedure.

Compliance with Ethics Guidelines

Conflict of Interest Michael E. Kelly, Danielle Courtney, Greg J. Nason, Des C. Winter declare no conflict 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.

References

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

1. Ramamurthy R, Duraipandian A. Morbidity and outcomes of pelvic exenteration in locally advanced pelvic malignancies. *Indian J Surg Oncol*. 2012;3(3):231–5.
2. •• Kuhrt MP, Chokshi RJ, Arrese D, et al. Retrospective review of pelvic malignancies undergoing pelvic exenteration. *World J Surg Oncol*. 2012;10:110. *Comprehensive retrospective review of the role of pelvic exenterative surgery for several pelvic malignancies*
3. Kim J. Pelvic exenteration: surgical approaches. *J Korean Soc Coloproctol*. 2012;28(6):286–93.
4. Bricker EM. Bladder substitution after pelvic exenteration. *Surg Clin MortnAm*. 1950;30:1511–21.
5. Carter MF, Dalton DP, Garnett JE. Simultaneous diversion of the urinary and fecal stream utilizing a single abdominal stoma: the double barrelled wet colostomy. *J Urol*. 1989;141:1189–91.
6. Zoucas E, Frederiksen S, Lydrup ML, et al. Pelvic exenteration for advanced and recurrent malignancy. *World J Surg*. 2010;34:2177–84.
7. Wong CS, Cumming BJ, Briedly JDS, et al. Treatment of locally recurrent rectal carcinoma: results and prognostic factors. *Int J Radiat Oncol Biol Phys*. 1998;40:427–35.
8. Brunschwig A. Complete excision of pelvic viscera for advanced carcinoma; a one stage abdominoperineal operation with end colostomy and bilateral ureteral implantation into the colon above the colostomy. *Cancer*. 1948;1:177–83.
9. Speicher PJ, Turley RS, Sloane JL, et al. Pelvic exenteration for the treatment of locally advanced colorectal and bladder malignancies in the modern era. *J Gastrointest Surg*. 2014;18:782–8.
10. Xin KY, Ng WJ, Tan GHC et al. Role of pelvic exenteration in the management of locally advanced primary and recurrent rectal cancer. *J Gastrointest Cancer*. 2014; Feb DOI [10.1007/s12029-014-9586-y](https://doi.org/10.1007/s12029-014-9586-y).
11. Pawlik TM, Skibber JM, Rodriguez-Bigas MA. Pelvic exenteration for advanced pelvic malignancies. *Ann Surg Oncol*. 2005;13(5):612–23.
12. Finlayson CA, Eisenberg BL. Palliative pelvic exenteration: patient selection and results. *Oncology*. 1996;10:179–484.
13. Lopez MJ, Kraybill WG, Downey RS, et al. Exenterative surgery for locally advanced rectosigmoid cancers. Is it worthwhile? *Surgery*. 1987;102:644–51.
14. Falk RE, Moffat FL, Makowka L, et al. Pelvic exenteration for advanced primary and recurrent adenocarcinoma. *Can J Surg*. 1985;28:539–41.
15. Ledesma EJ, Bruno S, Mitelman A. Total pelvic exenteration in colorectal disease: a 20-year experience. *Ann Surg*. 1981;194:701–3.
16. Law WL, Chu KW, Choi HK. Total pelvic exenteration for locally advanced rectal cancer. *J Am Coll Surg*. 2000;190:78–83.
17. Jimenez RE, Shoup M, Cohen AM, et al. Contemporary outcomes of total pelvic exenteration in the treatment of colorectal cancer. *Dis Colon Rectum*. 2003;46:1619–25.
18. Gannon C, Zager J, Chang G, et al. Pelvic exenteration affords safe and durable treatment for locally advanced rectal carcinoma. *Ann Surg Oncol*. 2007;14(6):1870–7.
19. Moriya Y, Akasu T, Fujita S, et al. Total pelvic exenteration with distal sacrectomy for fixed recurrent rectal cancer in the pelvis. *Dis Colon Rectum*. 2004;47:2047–53.
20. Goldberg JM, Piver MS, Hempling RE, et al. Improvements in pelvic exenteration: factors responsible for reducing morbidity and mortality. *Ann Surg Oncol*. 1998;5:399–406.
21. Jemal A, Siegel R, Ward E, et al. Cancer statistics 2008. *CA Cancer J Clin*. 2008;58(2):71–96.
22. Heidenreich A, Bastian PJ, Bellmunt J et al. Guidelines on Prostate cancer. European Association of Urology. 2013. www.uroweb.org/gls/pdf/09_Prostate_Cancer_LR.pdf.
23. Quinn M, Babb P. Patterns and trends in prostate cancer incidence, survival, prevalence and mortality. *BJU Int*. 2002;90(2):162–73.
24. Fowler JE, Bigler SA, White PC, et al. Hormone therapy for locally advanced prostate cancer. *J Urol*. 2002;168:546–9.
25. Anast JW, Andriole GL, Grubb RL. Managing the local complications of locally advanced prostate cancer. *Current Urology Reports*. 2007;8:211–6.
26. Ocfelein MG. Prognostic significance of obstructive uropathy in advanced prostate cancer. *Urology*. 2004;63:1117–21.
27. • Sridharan S, Warde P. The importance of local control in high-risk locally advanced prostate cancer. *Curr Oncol*. 2012;19(3):6–12. *Good review article outlining the issues surrounding the treatment and management of the complications of locally advanced prostate cancer*
28. Bastian PJ, Boorjian SA, Bossi A, et al. High-risk prostate cancer: from definition to contemporary management. *Eur Urol*. 2012;61:1096–106.
29. Cox JM, Busby JE. Salvage therapy for prostate cancer recurrence after radiation therapy. *Current Urology Reports*. 2009;10:199–205.
30. Engelhardt PF, Riedl CR. Palliative transurethral prostate resection for bladder outlet obstruction in patients with locally advanced prostate cancer. *J Urol*. 2005;173:324–5.
31. Bowrey DJ, Otter MI, Billings PJ. Rectal infiltration by prostatic adenocarcinoma: report on six patients and review of the literature. *Ann R Coll Surg Eng*. 2003;85:382–5.
32. Berek JS, Howe C, Lagasse LD, et al. Pelvic exenteration for recurrent gynaecological malignancy: survival and morbidity analysis of the 45-year experience at UCLA. *Gynecol Oncol*. 2005;99:153–9.
33. Zinke H. Radical prostatectomy and exenterative procedures for local failure after radiotherapy with curative intent: comparison of outcomes. *J Urol*. 1992;147:894–9.
34. Esnaola NF, Cantor SB, Johnson ML, et al. Pain and quality of life after treatment in patients with locally recurrent rectal cancer. *J Clin Oncol*. 2002;20:4361–7.
35. Ferenschild FT, Vermaas M, Nuytens JJ, et al. Value of intra-operative radiotherapy in locally advanced rectal cancer. *Dis Colon Rectum*. 2006;49:1257–65.
36. •• Ferenschild FT, Vermaas M, Verhoef C et al. Total pelvic exenteration for primary and recurrent malignancies. *World J Surg*. 2009;33:1502–1508. *Good comprehensive retrospective review of the role of pelvic exenteration surgery for several pelvic cancers. Highlights the improved survival associated with this surgery in appropriately selected patients*
37. Nash GF, Turner KJ, Hickish T, et al. Interactions in the aetiology, presentation and management of synchronous and metachronous adenocarcinoma of the prostate and rectum. *Ann R Coll Surg Eng*. 2012;94(7):456–62.
38. Seretis C, Seretis F, Liakos N. Multidisciplinary approach to synchronous prostate and rectal cancer: Current experience and future challenges. *J Clin Med Res*. 2014;6(3):157–61.
39. •• Kavanagh DO, Quinlan DM, Armstrong JG et al. Management of synchronous rectal and prostate cancer. *Int J Colorectal Dis*. 2012;27:1501–1508. *Largest series of synchronous rectal and prostate cancer reported. Makes very relevant points regarding*

the difficulties in the management of these patients due to differences in radiotherapy doses

40. Swedish rectal cancer trial. Improved survival with preoperative radiotherapy in resectable rectal cancer. *N Engl Med.* 1997;336(14):980–7.
41. Sauer R, Becker H, Hohenberger W, et al. Pre-operative versus post-operative chemoradiotherapy for rectal cancer. *N Engl Med.* 2004;351(17):1731–40.
42. Kamat AM, Huang SF, Bermejo CE, et al. Total pelvic exenteration: effective palliation of perianal pain in patients with locally recurrent prostate cancer. *J Urol.* 2003;170(5):1868–71.
43. Leibovici D, Pagliaro L, Rosser CJ, et al. Salvage surgery for bulky local recurrence of prostate cancer following radical prostatectomy. *J Urol.* 2005;173:781–3.
44. Wang HT, Yao YH, Li BG. Factors associated with survival of prostate cancer patients with rectal involvement. *Diagn Pathol.* 2014;9:35.
45. Woodhouse CGJ, Plail RO, Schlesinger PE, et al. Exenteration as palliation for patients with advanced pelvic malignancy. *BJU Int.* 1995;76(3):315–20.
46. Kakuda JT, Lamont JP, Chu DZ, et al. The role of pelvic exenteration in the management of recurrent rectal cancer. *Am J Surg.* 2003;186:660–4.
47. Crowe PJ, Temple WJ, Lopez MJ, et al. Pelvic exenteration for advanced pelvic malignancy. *Semin Surg Oncol.* 1999;17:152–60.
48. Bladou F, Houvenaeghel G, Delperio JR. Incidence and management of major urinary complications after pelvic exenteration for gynaecological malignancies. *J Surg Oncol.* 1995;58:91–6.
49. Jakowatz JG, Porudominsky D, Riihimaki DU, et al. Complications of pelvic exenteration. *Arch Surg.* 1985;120:1261–5.
50. Goldberg GL, Sukumvanich P, Einstein MH, et al. Total pelvic exenteration: The Albert Einstein College of Medicine/Montefiore Medical Center Experience (1987–2003). *Gynecol Oncol.* 2006;101(2):261–8.