Radical Cystectomy for Bladder Cancer: Morbidity of Laparoscopic Versus Open Surgery

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Abbreviations and Acronyms

ASA = American Society of Anesthesiologists

CT = computerized tomography

LS = laparoscopic surgery

OS = open surgery

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Purpose: We compared the morbidity and mortality of laparoscopic vs open surgery in radical cystectomy for bladder cancer.

Materials and Methods: This prospective, nonrandomized study was conducted between January 2003 and July 2007 in 68 patients (7 women and 61 men) who underwent radical cystectomy for bladder cancer. A total of 38 cystectomies were performed laparoscopically and 30 by open surgery. Mean patient age was 68.0 ± 9.0 years. Median preoperative American Society of Anesthesiologists score was 2 (range 1 to 3) in both groups.

Results: Intraoperative blood loss and transfusion rate were significantly lower in the laparoscopic surgery group. Postoperatively the incidence of minor complications and mortality were also significantly lower. Postoperative opioid consumption was significantly less in the laparoscopic surgery group in amount and duration. Resumption of oral fluid and solid intake as well as return to normal bowel function were significantly more rapid in the laparoscopic surgery group, and mean hospital stay was significantly shorter. Mean patient followup was 30.5 ± 17.2 months.

Conclusions: Laparoscopic radical cystectomy for bladder cancer has a lower morbidity rate than cystectomy by open surgery. It allows more rapid resumption of oral fluid and solid intake as well as return to normal bowel function and shorter hospital stay.

Key Words: urinary bladder neoplasms, laparoscopy, morbidity, cystectomy

RADICAL cystectomy with lymph node dissection is the reference treatment for invasive and superficial high grade bladder tumors which have recurred after conservative treatment.[1] Cystectomy using laparotomy is associated with high morbidity and mortality.[2–10] It has also been reported that morbidity is related to patient characteristics, particularly ASA score.[4]

However, some authors have reported that laparoscopic radical cystectomy for bladder cancer is associated with lower morbidity.[2,6,11–15] To date only 3 studies have compared this technique with cystectomy by open surgery.[2,3,6] With laparoscopy they found significantly reduced postoperative use of analgesics, more rapid return to normal bowel function, shorter time to resumption of fluid and solid intake, and shorter hospital stay. However, the series in these studies were small. In this study we compared the morbidity and mortality of laparoscopic cystectomy vs open surgery for bladder cancer.

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MATERIALS AND METHODS

Patients

This prospective nonrandomized study was performed in 68 consecutive patients, 7 women and 61 men, mean age 68.0 ± 9.0 years, who underwent radical cystectomy for bladder cancer between January 2003 and July 2007. There were 38 laparoscopic and 30 open procedures. The median preoperative ASA score was the same in both patient groups at 2 (range 1 to 3). The preoperative characteristics of the 2 groups are shown in table 1.

The indication for surgery was an invasive bladder tumor in 53 cases and high grade superficial bladder tumor refractory to conservative treatment (chemotherapy, immunotherapy) in 10. The preoperative histopathological findings are shown in table 1. Due to the lack of medium term oncological results for laparoscopic cystectomy, we only used laparoscopy in patients with preoperative clinical and CT tumor stage lower than T3b. Patients with a history of abdominal surgery, spontaneous pneumothorax, retinal detachment or tumor stage higher than T3A on preoperative CT were selected for the open procedure.

The records of all patients who underwent laparoscopic radical cystectomy were prospectively reviewed and compared to a cohort of patients who underwent open radical cystectomy during the same period at our institution. Two patients in the OS group had neoadjuvant chemotherapy for locally advanced bladder cancer.

Preoperative Evaluation

Before surgery all patients underwent investigations for distant metastases including bone scintigraphy, and CT of the chest, abdomen and pelvis. All cases were considered M0. Urine culture was routinely performed on hospital admission to detect and treat any urinary infection. Preoperative bowel preparation consisted of a no fiber diet for 5 days before surgery and ingestion of 1.5 l macrogol 3350 solution (Colopeg®) the day before surgery. Patients received an injection of low molecular weight heparin the day before surgery and wore support stockings.

Operative Technique

The procedure was performed by 6 surgeons (4 senior and 2 junior). The surgeons were trained the same on open as laparoscopic surgery. In men laparoscopic cystoprostatectomy was performed according to the technique previously described.[15] Laparoscopic anterior pelvic exenteration was performed according to the technique of Moinzadeh et al.[14] The operative specimen was removed via a small median subumbilical incision. Both ureters were located and catheterized using 8Fr catheters. In Bricker diversions the ureters were drained with single-J catheters. Ureteral reconstruction and reimplantation were performed via subumbilical mini-laparotomy. Cystoprostatectomy and anterior pelvic resection by open surgery were performed using conventional techniques. Extended lymphadenectomy was performed in all cases.

Urinary diversion was performed according to age, general condition, tumor stage, renal function and patient preference. The ileal conduit is a popular technique of urinary diversion after radical cystectomy. Ileal neobladder reconstruction was performed only in selected patients with usable urethra. Noncontinent transileal ureterostomy was performed using Bricker's technique in 27 cases. An ileal neobladder was constructed in 33 cases (26 using Camey's technique, 3 using the Padua technique, 3 Hautmann's technique and 1 with the Mainz technique). Two bilateral cutaneous ureterostomies were performed. The modes of urinary diversion are presented in table 2.

Postoperatively patients received morphine via a patient controlled pump. Patients were mobilized on postoperative day 1. The nasogastric tube was removed in the recovery room. Feeding was reintroduced gradually. On postoperative day 1 it consisted essentially of fluids (drinks and broth). Other foods were introduced on postoperative day 2 according to tolerance.

Parameters Studied

Preoperative parameters studied were patient age, body mass index, gender, ASA score, total serum protein and serum creatinine. Intraoperative data studied were the duration of cystectomy itself and total operative time, intraoperative blood loss, number and type of intraoperative complications, and transfusion rate. Postoperative data studied were serum hemoglobin, total serum protein and serum creatinine, duration of stay in the intensive care unit, duration of hospital stay, major and minor complications, transfusion rate, time to return of normal bowel function and to resumption of liquid and solid food intake, and opioid use. Postoperative ileus was defined as a period of more than 5 days before return of normal bowel

Table 1. *Preoperative characteristics*

	Laparoscopy	Open Surgery	p Value
No. pts	38	30	Not significant
Mean age ± SD	67.9 ± 9.0	64.9 ± 12.3	Not significant
Mean body mass index ± SD	25.9 ± 3.6	26.1 ± 4.3	Not significant
No. sex:			
Men	36	25	Not significant
Women	2	5	
Median ASA score (range):	2 (1–3)	2 (1–3)	Not significant
1	6	1	
2	24	17	
3	8	12	
No. invasive tumor (at least pT2)	30	23	Not significant
No. superficial high grade tumor refractory to conservative treatment	8	7	
No. history of abdominal/pelvic surgery (%)	5 (13.1)	10 (33.3)	0.046

Table 2. *Intraoperative characteristics*

	Laparoscopy	Open Surgery	p Value
Mean total surgical mins ± SD	382.2 ± 92.1	334.1 ± 93.1	0.039
Mean mins cystectomy ± SD	221.1 ± 50.2	152.4 ± 52.5	<0.001
Mean ml blood loss ± SD	429.7 ± 335.9	923.2 ± 532.5	<0.001
No. transfusions (%)	3 (7.9)	11 (36.7)	0.004
No. intraop deaths (%)	0 (0)	0 (0)	Not significant
No. conversions (%)	2 (5.26)	—	—
No. urinary diversions:			0.0239
Noncontinent Bricker ileal conduit	13	20	
Ileal neobladder	24	9	
Cutaneous ureterostomy	1	1	

function. Early postoperative complications were those occurring within 30 days of surgery and late complications were those occurring more than 30 days after surgery. Minor complications were defined as those requiring only medical treatment or observation, and major complications as those which required admission to the intensive care unit or repeat surgery, or which were potentially fatal.

Statistical Analysis

Quantitative values were compared with Student's t test. Qualitative values were compared with the chi-square test or Fisher's exact test and $p < 0.05$ was considered statistically significant.

RESULTS

Demographic data are shown in table 1. There was no significant difference between the populations of the 2 groups. The incidence of prior abdominal surgeries was higher in OS group than in the LS group (33.3% vs 13.1%, $p = 0.046$).

Intraoperative data are shown in table 2. Operative time differed significantly between the 2 groups for cystectomy (LS group 221.1 ± 50.2 minutes, OS group 152.4 ± 52.5 minutes, $p < 0.001$), as did total operative time (LS group 382.2 ± 92.1 minutes, OS group 334.1 ± 93.1 minutes, $p = 0.039$), blood loss (LS group 429.7 ± 335.9 ml, OS group 923.2 ± 532.5 ml, $p < 0.001$) and intraoperative transfusion rate (7.89% of LS patients, 36.7% of OS patients, $p = 0.004$). There were 2 conversions to open surgery. One concerned an injury to the external iliac artery which could not be controlled under laparoscopy, and the other was bladder perforation which compromised oncological safety.

Postoperative data showed significantly lower postoperative morbidity in the LS group than in the OS group for minor complications (28.9% vs 60.0%, $p = 0.011$) (table 3). No significant difference was noted for major complications. The postoperative transfusion rate was significantly lower in the LS group than in the OS group (18.4% vs 50.0%, $p = 0.006$). Medium protein serum rates were significantly lower in both groups after surgery (67.3 vs 48.7 gm/l, $p < 0.0001$ in the LS group; 75.3 vs 56.0 gm/l, $p < 0.0001$ in the OS group). Postoperative opioid use was significantly lower in the LS group than in the OS group in duration (33.5 ± 26.4 vs 54.8 ± 25.2 hours, $p = 0.003$) and in quantity (21.2 ± 20.6 vs 41.2 ± 35.8 mg, $p = 0.012$). Time to normal bowel function, and to liquid and solid food intake was significantly decreased in the LS group ($p = 0.010$, $p = 0.009$, $p = 0.006$, respectively). In

Table 3. *Postoperative characteristics*

	Laparoscopy	Open Surgery	p Value
No. transfusions (%)	7 (18.4)	15 (50.0)	0.006
No. periop deaths (%)	0 (0)	2 (6.7)	Not significant
No. major early complications (%)	3 (7.9)	7 (23.3)	Not significant
No. minor early complications (%)	10 (26.3)	18 (60.0)	0.005
Mean days in intensive care ± SD	4.2 ± 1.3	8.4 ± 7.0	<0.001
Mean days to fluid intake ± SD	2.1 ± 1.3	4.4 ± 5.3	0.009
Mean days to oral food intake ± SD	3.8 ± 1.5	6.4 ± 5.4	0.006
Mean days to normal bowel function ± SD	3.9 ± 1.9	7.2 ± 6.7	0.010
Opioid use:			
No. (%)	30 (78.9)	30 (86.7)	Not significant
Mean hrs ± SD	33.5 ± 26.4	54.8 ± 25.2	0.003
Mean mg ± SD	21.2 ± 20.6	41.2 ± 35.8	0.012
Mean postop days in hospital ± SD	12.7 ± 4.1	15.6 ± 6.1	0.033
No. repeat surgery (%)	1 (2.6)	2 (6.7)	Not significant
No. late complications (%)	9 (23.6)	14 (41.2)	Not significant

Table 4. *Postoperative complication rates*

	Total No. (%)	No. Laparoscopy (%)	No. Open Surgery (%)	p Value
Minor complications:				
Paralytic ileus	13 (19.1)	4 (10.5)	9 (30.0)	0.043
Parietal complications	9 (13.2)	2 (5.25)	7 (23.3)	0.029
Febrile syndrome	8 (11.7)	4 (10.5)	4 (13.3)	Not significant
Confusional syndrome	6 (8.8)	2 (5.25)	4 (13.3)	Not significant
Minor pulmonary complications	3 (4.4)	0 (0)	3 (10.0)	0.046
Major complications:				
Deep venous thrombosis	1 (1.47)	1 (2.6)	0 (0)	Not significant
Urinary peritonitis	1 (1.47)	1 (2.6)	0 (0)	Not significant
Pouchitis	1 (1.47)	1 (2.6)	0 (0)	Not significant
Cardiopulmonary decompensation	3 (4.4)	0 (0)	3 (10.0)	0.046
Severe sepsis, deep abcess	3 (4.4)	0 (0)	3 (10.0)	0.046
Evisceration	2 (2.9)	1 (2.6)	1 (3.3)	Not significant

terms of morbidity the data showed no difference between ileal conduit and ileal neobladder (major complications 6.1% vs 21.1%, p = 0.073; minor complications 54.5% vs 33.3%, p = 0.083). Mean duration of hospitalization in intensive care and of total hospital stay were significantly lower in the LS group than in the OS group (4.2 ± 1.3 vs 8.6 ± 7.0 days, respectively, p <0.001, and 12.7 ± 4.1 vs 15.6 ± 6.1 days, respectively, p = 0.033).

Table 4 shows major and minor complications as well as their incidence in each group. There were significantly fewer cases of postoperative ileus, parietal complications and minor pulmonary complications in the LS group than in the OS group (10.5% vs 30.0%, p = 0.043; 5.25% vs 23.3%, p = 0.029; 0% vs 10.0%, p = 0.046, respectively). There were also significantly lower rates of deep abscess or severe sepsis in the LS group than in the OS group (0% vs 10%, p = 0.046).

The final histopathological results are given in table 5. There were significantly more cases of locally advanced tumor stage (stages pT3b or greater and pT4) and lymph node invasion in the OS group (50.0% vs 7.8%, p <0.0001 and 30% vs 10.5%, p = 0.043, respectively). The nodal counts were 10.5 ± 3.8 in the OS group and 11.9 ± 5.3 in the LS group. No statistical significant difference was shown. At a mean followup of 30.5 ± 17.2 months no significant difference was observed between the 2 groups with regard to late complications. Also, no cases of peritoneal carcinomatosis and of port site metastases were noted in the LS group.

DISCUSSION

Radical cystectomy with lymph node dissection is the reference treatment for invasive or superficial high grade bladder tumors which are recurrent after conservative treatment.[1] Controlling cancer progression, rapid postoperative recovery and satisfactory quality of life are the 3 goals of oncological surgery. Radical cystectomy has a morbidity rate of 25% to 35% and up to 4% mortality.[4,5,7–10] The main cause of morbidity is postoperative ileus. Morbidity has also been reported to be related to ASA score particularly if the score is 3 or higher.[4]

Laparoscopic surgery has been shown to provide significant benefits in various urological procedures. We compared laparoscopic radical cystectomy to the open approach. We showed that laparoscopic radical cystectomy is associated with decreased intraoperative and postoperative morbidity and mortality, lower opioid consumption and shorter hospital stay. However, the operative time is longer. Basillote[2] and Porpiglia[6] et al, and Hemal and Kolla[3] previ-

Table 5. *Final histopathological results*

	Laparoscopy	Open Surgery	p Value
No. tumor stage (%):			0.0025
pT0	2 (5.2)	1 (3.3)	
pTa	2 (5.2)	0 (0)	
pTis	4 (10.4)	0 (0)	
pT1	7 (15.6)	5 (16.7)	
pT2a	4 (10.4)	2 (6.6)	
pT2b	5 (13.0)	3 (10.0)	
pT3a	13 (33.2)	4 (13.3)	
pT3b	0 (0)	1 (3.3)	
pT4a	3 (7.8)	14 (46.7)	
pT4b	0 (0)	0 (0)	
Mean lymph nodes retrieved ± SD	11.9 ± 5.3	10.5 ± 3.8	Not significant
No. lymph node invasion (%):			0.043
pN0	34 (89.5)	21 (70.0)	
pN1 or greater	4 (10.5)	9 (30.0)	
Median WHO tumor grade 1973 (range)	3 (3–3)	3 (2–3)	Not significant
No. resection margins (%):			Not significant
R0	34 (89.5)	23 (76.7)	
R1	4 (10.5)	7 (23.3)	
No. histology (%):			Not significant
Urothelial Ca	37 (97.3)	25 (82.3)	
Squamous cell Ca	1 (2.7)	3 (10.0)	
Sarcomatous Ca	0 (0)	2 (6.7)	
No./total No. prostate Ca (%)	9/36 (25.0)	4/25 (16.0)	Not significant

ously reported that laparoscopy was only advantageous with regard to the postoperative use of analgesics, time to return of normal bowel function and oral feeding, and length of hospital stay. Surprisingly they found no advantage in terms of morbidity and mortality. However, their series were small. On the other hand all studies assessing laparoscopic radical cystectomy for bladder cancer emphasize the low morbidity rate.[6,11,12,14–16]

Laparoscopy decreases postoperative ileus. This is the most frequent complication after cystectomy and a common cause of a prolonged hospital stay.[5,7,10] Contributory factors are use of analgesics, anesthesia, intestinal manipulation during surgery and peritoneal inflammation resulting from the procedure. Laparoscopy allows earlier return to oral feeding as it reduces manipulation of the digestive loops as well as postoperative opioid use.[2,3,6,11–13,17] Postoperatively we removed the nasogastric tube within 6 hours. In addition, because of the absence or small size of the parietal incisions, we found that after laparoscopy ambulation was possible as early as postoperative day 2. This shortens time to flatus and oral feeding, and decreases the risk of pulmonary complications.[5,10] In parallel, early return to oral feeding contributes to early restoration of bowel function.[5,7,10]

Because the technique is more delicate and precise, and because of pneumoperitoneum and excellent visibility, laparoscopy also achieves better hemostasis, resulting in minimal blood loss, and low intraoperative and postoperative transfusion rates.[2,3,6,11–15] In our series blood loss and the number of patients requiring transfusions were significantly lower in the LS group. However, transfusion rates in both groups were higher than those previously reported, probably related to hemodilution.

Nonautologous transfusion has been reported to increase the risk of parietal complications through immunosuppression.[18] Two patients (5.25%) in the LS group presented parietal complications, an incidence lower than that usually reported. Laparoscopy is associated with a low incidence of infectious complications due to shorter exposure of the abdominal cavity to the ambient air and, according to Targarona et al, less involvement of the immune system.[19]

Total operative time was significantly longer in the LS group due to the time required for the cystectomy itself. In our series cystectomy time was longer than that reported in the literature.[2,3,6,11,12,16] However, it was similar to those reported in the international register of laparoscopic cystectomies.[13] The longer operative time was not associated with increased morbidity. Also, none of our patients presented complications related to prolonged bed rest and immobilization.

To make the technique easier and to reduce operative time we performed urinary diversion by mini-laparotomy. This does not appear to decrease the advantages of laparoscopy. On the contrary, Haber et al have reported that urinary diversion performed with the intracorporeal approach was associated with a higher rate of morbidity and repeat surgery than mini-laparotomy.[20] The reason for this finding may be that cystectomies in which the gastrointestinal part of the procedure is performed under laparoscopy do not subject the vascular system or tissue integrity to stress. Laparoscopy may also involve the risk of dissemination of gastrointestinal fluid, make digestive loop anastomosis more difficult and be more tiring for the surgeon.[20]

The average hospital stay after radical cystectomy was lower in the LS group than in the OS group. Thus, the average stay after radical cystectomy has been reported to be shorter at American centers compared with European centers. There seems to be a large difference in the average stay for surgical procedures between European and American hospitals, which may result partly from cultural and social factors, but depends on financial aspects of the respective health care systems.

Due to advanced tumor stage we prefer to perform an open procedure in female patients. From an oncological viewpoint we noted that in our series tumor stage was significantly higher in the OS group than in the LS group, whereas preoperatively there was no significant difference between the 2 groups. These results are similar to those reported in the literature. In our practice and in the absence of medium term oncological results of laparoscopic cystectomy, we only use laparoscopy in patients whose preoperative clinical and CT tumor stage is lower than T3b. Furthermore, we believe that the laparoscopic approach can be proposed to all these patients except those with contraindications to laparoscopic surgery. We obtained good comparable results between laparoscopic and open radical cystectomy due to long-term experience and well trained staff including the surgeons, anaesthesists, residents and nurses.

CONCLUSIONS

Laparoscopic radical cystectomy for bladder cancer has a lower morbidity rate than cystectomy by open surgery. Although the operative time is longer, the laparoscopic technique results in reduced blood loss and postoperative opioid use, more rapid resumption of oral fluid and solid intake and return to normal bowel function, and shorter hospital stay.

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EDITORIAL COMMENT

Defining the role of minimally invasive surgery for muscle invasive bladder carcinoma remains a challenge. In patients undergoing laparoscopic cystectomy Guillotreau et al reported decreased blood loss, opiate use and time to return of bowel function compared to open cystectomy. However, laparoscopic surgery was associated with a considerably longer operative time. Although not demonstrated in this study, prolonged operative time can be associated with increased perioperative complications including venous thrombosis and ileus. Robotic assistance may serve in reducing operative time during laparoscopic cystectomy. The use of this technology has been reported to shorten the learning curve of pelvic laparoscopic surgery and allow procedures to be performed by surgeons without extensive laparoscopic experience.[1] In addition, enhanced 3-dimensional visualization and maneuverability of the robotic instruments may improve yield during lymphadenectomy, and facilitate adherence to current recommendations regarding lymph node sampling.[2] These potential advantages of robotic assisted surgery need further validation in light of the increased incremental costs associated with this technology.

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