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ORIGINAL ARTICLE – COLORECTAL CANCER

Outcomes of Early Removal of Urinary Catheter Following Rectal Resection for Cancer

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ABSTRACT

Purpose. Early postoperative urinary catheter removal decreases urinary tract infection (UTI) rate and accelerates patient mobilization. The aim of this study is to determine the results of systematic urinary catheter removal on postoperative day (POD) 1 in patients undergoing rectal resection for cancer.

Patients and Methods. Using a prospectively maintained database of 469 patients who underwent rectal resection for cancer, a retrospective review of all patients with urinary catheter removal on POD1 was conducted. Patients unable to void 6 h after catheter removal underwent in and out urinary catheterization (IOC group) and were compared with patients who voided spontaneously (non-IOC group) to determine risk factors for IOC.

Results. A total of 417 patients were identified, including 274 (66%) men. Median age was 59 (50–68) years. Abdominoperineal resection (APR) was performed in 134 (32%), and complex surgery with resection of at least one other organ in 72 (17%) patients. Non-IOC and IOC groups included 245 (59%) and 172 (41%) patients, respectively. Five independent predictive factors for IOC were male gender, obesity, history of obstructive urinary disease, APR, and metastatic disease. The cumulative risk of IOC in patients with zero, one, two, and at least three risk factors was 8%, 31%, 52%, and 68% on POD1, and 2%, 12%, 23%, and 30% on POD5, respectively ($p < 0.001$). Thirteen patients (3%) developed UTI.

Conclusions. Early removal of urinary catheter resulted in 59% of patients voiding spontaneously with no need for IOC following rectal resection. Patients without any predictive factors had less than 10% risk of urinary dysfunction.

Urinary dysfunction is a known complication following rectal surgery. Autonomic nerve injury and urinary tract manipulation impair bladder contractility and can lead to outlet obstruction.[1] In the early postoperative course, urinary dysfunction leads to acute urinary retention, which can result in overdistension and persistent bladder dysfunction. The rate of acute urinary retention following rectal resection ranges from 5 to 30%,[2–9] and surgery for low-rectal adenocarcinoma results in higher rates of urinary dysfunction compared with other rectal resections.[10]

The majority of instances of postoperative urinary dysfunction are temporary conditions, and the incidence varies based on the time of urinary catheter removal.[4,5,10] To decrease rates of urinary dysfunction, recommendations have been made to prolong urinary decompression for at least 3 days following low-rectal cancer resection.[2,5,6,10] However, prolonged decompression increases the risk of urinary tract infection (UTI) and limits early postoperative mobilization. Following rectal cancer surgery, the rate of UTI ranges from 2 to 10%.[4–6,8,10] After any major surgery, the risk of UTI is twice as high for those with an indwelling catheter in place longer than 2 days.[11] Few studies have demonstrated the feasibility of urinary catheter removal on the first postoperative day,[4,5,7,8,10] with most noting a decrease in UTIs. However, early removal of catheter was associated with an increase in incidence of postoperative urinary retention. In this study, we propose a standard postoperative urinary management consisting of urinary catheter removal on postoperative day (POD) 1 followed by in and out catheterization (IOC) in patients with urinary dysfunction.

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The aim of this study is to determine the outcomes of systematic urinary catheter removal on POD1 in patients undergoing rectal resection for cancer.

PATIENTS AND METHODS

Patients

Utilizing a prospectively maintained database, a retrospective review of all patients who underwent curative intent rectal resection for cancer between January 2012 and August 2016 was conducted. Exclusions included patients with preoperative permanent indwelling catheters and a need for ongoing postoperative catheterization (hemodynamic instability, need for strict monitoring of urinary output). Patients requiring cystoscopic urinary catheter placement in the operating room, the need for concurrent cystoprostatectomy, treatment with intraoperative radiotherapy, and perineal reconstruction requiring urinary catheter maintenance were also excluded. The Mayo Clinic Institutional Review Board approved the study.

Patients were staged according to the tumor–node–metastasis (TNM) classification system as outlined by the National Comprehensive Cancer Network.[12] All rectal resections were performed in transabdominal fashion. Rectal cancers involving the external anal sphincter were treated with abdominoperineal resection and end-colostomy. Partial tumor-specific mesorectal excision (PME) was performed for high-rectal cancers. Low anterior resection (LAR) with total mesorectal excision (TME) was performed for mid- and low-rectal cancers. The indication for diverting ileostomy was left to the surgeon's discretion.

Urinary Catheter Management and Enhanced Recovery Protocol

Urinary catheters were removed in all patients on POD1 between 6 and 8 AM. For those unable to spontaneously void within 6 h, in and out urinary catheterization (IOC) was taught. In and out catheterization was repeated every 6 h until resumption of spontaneous voiding. An indwelling catheter was replaced in patients unable or unwilling to perform IOC. For those unable to spontaneously void at time of discharge, IOC was continued. Frequency of IOC was defined so that postvoid residual remained < 400 ml. Patients were advised to decrease the frequency of IOC to three times per day when postvoid residual was < 300 ml and to two times per day for postvoid residual < 200 ml. IOC stopped when postvoid residual was < 150 ml for 2 days. In addition to early discontinuation of urinary catheters, postoperative care followed a standard enhanced recovery program (ERP).[13]

Outcomes

The main outcome measured was need for IOC following urinary catheter removal. Replacement of indwelling catheters for postoperative complications or strict urinary output quantification due to hemodynamic instability was not included in the IOC rate calculation. Secondary outcomes included rates of urinary catheterization at dismissal, postoperative urinary retention, urinary tract infections, and duration of catheterization. Duration was defined as the time between the first and last IOC or between the first IOC and removal of the replaced indwelling catheter. Acute postoperative urinary retention was defined as inability to void despite significant urge, requiring urinary catheterization and urine volume at catheterization > 400 ml.

To determine risk factors for IOC, patients who required IOC (IOC group) were compared with patients who voided spontaneously after urinary catheter removal (non-IOC group) using univariate and a multivariate analysis including perioperative and peroperative characteristics. Obstructive urinary disease was defined as any disease resulting in obstructive urinary symptoms. Postoperative prolonged or recurrent ileus was defined according to criteria outlined by Vather et al.[14] Complications graded Clavien–Dindo ≥ 3 were considered as severe.[15]

Statistical Analysis

Qualitative and quantitative data are expressed as *n* (%) and median (interquartile range), respectively. Univariate analyses were performed using Fisher's exact test for qualitative data and *t* test for quantitative data. Multivariate analyses consisted of a logistic regression including all data reaching p value < 0.1 on univariate comparison. p value < 0.05 was considered statistically significant. Statistical analysis was performed using JMP®Pro (SAS Institute, version 10.0).

RESULTS

Patients

From a prospective cohort of 469 patients who underwent rectal resection for cancer between 2011 and 2016, a total of 417 patients (274 male) underwent early removal of urinary catheter (Fig. 1). The median age of the cohort was 59 (50–68) years (Table 1). Resection of another organ was performed in 76 (18%) patients, including liver segments ($n = 51$), uterus and/or ovaries ($n = 17$), vaginal wall ($n = 6$), ileal or colonic segment ($n = 6$), extra-anatomical adenopathy ($n = 5$), and seminal vesicle ($n = 2$). Fifty-eight (14%) patients presented with history of obstructive

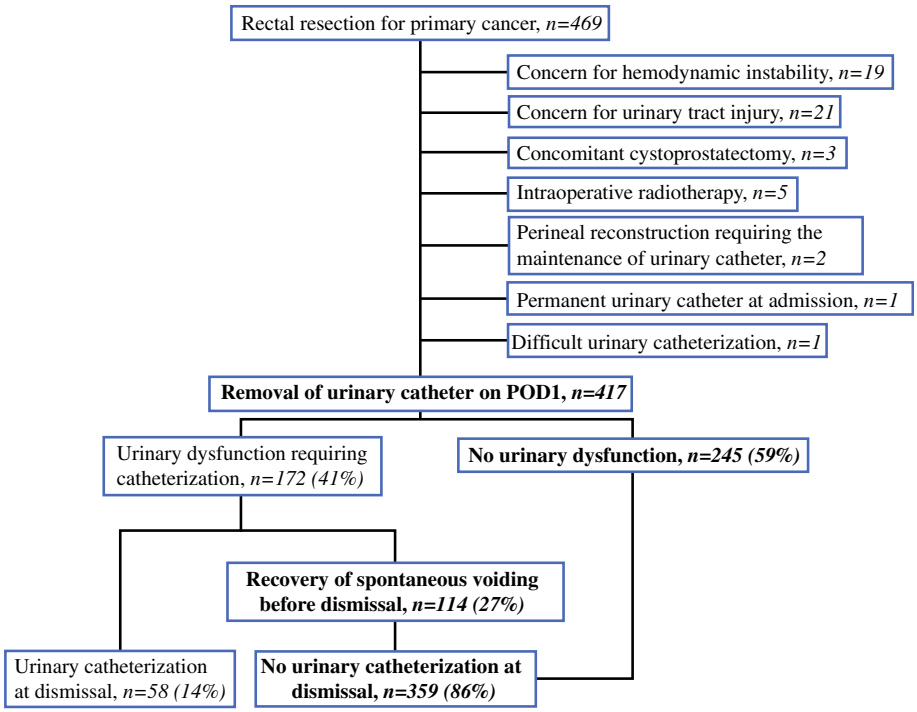

FIG. 1 Selection process of the patients included in the study

urinary disease, including benign prostatic hypertrophy (BPH, $n = 38$), urethral stricture ($n = 1$), urethral sling ($n = 1$), or undetermined cause ($n = 8$).

In and Out Catheterization Probability

Following urinary catheter removal on the first postoperative day, 245 (59%) patients were able to void spontaneously (non-IOC group) and 172 (41%) patients required IOC (IOC group). Patients who voided spontaneously on POD1 did not require any urinary catheterization for urinary dysfunction within the 3 postoperative months. An indwelling urinary catheter was replaced in 14 patients, including 11 unable or unwilling to perform IOC, 1 with a neobladder, and 1 with traumatic IOC. Postoperative urinary retention was reported in two (1%) patients with persistent urinary dysfunction at dismissal and who refused to pursue IOC or to replace an indwelling catheter. The median duration of urinary catheterization in the IOC group was 3 (1–12) days. The number of patients who required IOC decreased from 173 (41%) to 82 (20%) between POD1 and POD3. At POD5, 72 (17%) patients still required IOC. A total of 365 (86%) patients were dismissed without need for urinary catheterization after median length of stay of 5 (4–7) days. At 1 month, only 15 (4%) patients still required IOC.

Risk Factors for Postoperative In and Out Catheterization

IOC patients were significantly older, more often male, more often had metastatic disease, and presented with more severe comorbidities than non-IOC patients (Table 1). History of obstructive urinary disease was associated with need for postoperative catheterization. Need for IOC was significantly more frequent following abdominoperineal resection, open surgery, and estimated blood loss ≥ 300 ml. Significant risk factors for postoperative urinary catheterization identified by multivariate analysis were found to be obesity, male gender, history of obstructive urinary disease, APR, and metastatic disease (Table 2). The number of patients with zero, one, two, and at least three risk factors was 50 (12%), 151 (36%), 153 (37%), and 63 (15%) respectively. The probability of IOC on POD1 increased from 8% in patients without any risk factor to 31%, 52%, and 68% in patients with one, two, and at least three risk factors, respectively ($p < 0.001$). The risk of IOC at standardized temporal assessments also increased with the number of risk factors (Fig. 2). The rate of IOC in patients with zero, one, two, and at least three risk factors was 2%, 15%, 31%, and 41% at POD3 ($p < 0.001$), and 2%, 12%, 22%, and 30% at POD5 ($p < 0.001$).

TABLE 1 Characteristics of the patients undergoing rectal resection for cancer regarding the need for in and out catheterization (IOC) from postoperative day 1

Characteristic	Non-IOC (n = 245)	IOC (n = 172)	Total (n = 417)	p value
Age (years)	57 (48–65)	61 (53–71)	59 (50–68)	< 0.001*
Male gender	137 (55.9)	137 (79.6)	274 (65.7)	< 0.001*
ASA score				< 0.001*
1–2	203 (82.9)	116 (67.4)	319 (76.5)	
3–4	42 (17.1)	56 (32.6)	98 (23.5)	
BMI (kg/m^2)	27 (23–30)	28 (25–32)	27 (24–31)	0.005*
Diabetes mellitus	25 (10.2)	29 (16.9)	54 (12.9)	0.054
Previous abdominal surgery	88 (35.9)	56 (32.6)	144 (34.5)	0.530
History of obstructive urinary disease	19 (7.8)	39 (22.7)	58 (13.9)	<0.001*
History of prostate surgery	3 (1.2)	9 (5.2)	12 (2.9)	0.032*
History of prostate cancer	9 (3.7)	9 (5.2)	18 (4.3)	0.470
History of bladder surgery	5 (2.0)	2 (1.2)	7 (1.7)	0.705
Neoadjuvant radiation	160 (65.3)	108 (62.8)	268 (64.3)	0.605
Tumor location				
Upper rectum	56 (22.5)	29 (16.9)	85 (20.1)	0.339
Mid rectum	89 (36.7)	64 (37.2)	153 (36.9)	
Low rectum	100 (40.8)	79 (45.9)	179 (42.9)	
Procedure				0.019*
Anterior resection with PME	31 (12.7)	12 (7.0)	43 (10.3)	
LAR with TME	147 (60.0)	93 (54.1)	240 (57.6)	
APR	67 (27.3)	67 (38.9)	134 (32.1)	
Complex surgery[a]	41 (16.7)	31 (18.0)	72 (17.3)	0.793
Surgical approach				0.004*
Open	62 (25.3)	70 (40.7)	132 (31.7)	
Laparoscopic-assisted	98 (40.0)	54 (31.4)	152 (36.4)	
Robotic	85 (34.7)	48 (27.9)	133 (31.9)	
Operative time (min)	229 (167–299)	228 (176–318)	229 (171–301)	0.492
Estimated blood loss ≥ 300 ml	49 (20.0)	48 (27.9)	97 (23.3)	0.077
Intraoperative IV fluids (L)	2.6 (2.0–3.5)	2.8 (2.0–3.7)	2.6 (2.0–3.6)	0.188
Opioid in the first 48 h (MED)	36 (7–75)	37 (7–75)	37 (7–75)	0.714
Spinal block	208 (84.9)	151 (87.8)	359 (86.1)	0.473
Pathologic T stage				0.180
0–1	74 (30.2)	42 (24.4)	116 (27.8)	
2	76 (31.0)	49 (28.5)	125 (30.0)	
3	88 (35.9)	70 (40.7)	158 (37.9)	
4	7 (2.9)	11 (6.4)	18 (4.3)	
Pathologic N stage	70 (28.6)	65 (37.9)	136 (32.6)	0.056
Metastatic disease	24 (9.8)	32 (18.6)	56 (13.4)	0.013*
R1 resection	4 (1.6)	2 (1.2)	6 (1.4)	> 0.999

Data expressed as n (%) unless expressed as median (interquartile range)

APR abdominoperineal resection, *BMI* body mass index, *IQ* interquartile, *LAR* low anterior resection, *MED* morphine equivalent dose, *PME* partial tumor-specific mesorectal excision, *TME* total mesorectal excision

*Significant at p value < 0.05

[a]Defined by resection of more than one organ

TABLE 2 Multivariate analysis of the risk factors for IOC on postoperative day 1

Characteristic[a]	Odds ratio	95% CI	*p* value
Age ≥ 65 years	1.63	0.99–2.67	0.054
Male gender	2.58	1.58–4.30	< 0.001*
ASA score ≥ 3	1.64	0.95–2.84	0.076
BMI ≥ 30 kg/m^2	1.74	1.08–2.82	0.023*
Diabetes mellitus	0.84	0.41–1.69	0.633
History of obstructive urinary disease	2.28	1.18–4.49	0.015*
History of prostate surgery	2.59	0.67–12.92	0.198
Procedure			
Anterior resection with PME	Ref	–	
LAR with TME	1.98	0.91–4.57	0.631
APR	3.04	1.30–7.51	0.011*
Surgical approach			
Open	Ref	–	
Laparoscopic-assisted	0.79	0.43–1.45	0.724
Robotic	0.75	0.40–1.39	0.491
Estimated blood loss ≥ 300 ml	1.01	0.58–1.70	0.994
Pathologic *N* stage	1.28	0.79–2.05	0.329
Metastatic disease	2.14	1.07–4.36	0.033*

APR abdominoperineal resection, *BMI* body mass index, *LAR* low anterior resection, *PME* partial tumor-specific mesorectal excision, *TME* total mesorectal excision

[a]Only variables reaching *p* value < 0.1 on univariate analysis were included in the multivariate analysis

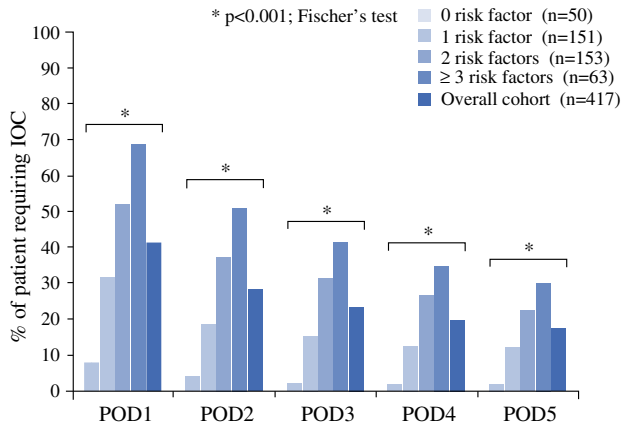

FIG. 2 Rate of IOC within the five first postoperative days (POD) according to the number of predictive factors

Postoperative Outcomes in IOC Patients

IOC patients suffered from more frequent severe complications (Dindo–Clavien ≥ 3) (7% vs. 20%; $p < 0.001$) and anastomotic leak (5% vs. 17% of the 270 patients with anastomosis; $p = 0.001$). The rate of prolonged or recurrent ileus was also higher in the IOC group (13% vs. 29%; $p < 0.001$). Thirteen patients (3%) suffered from urinary tract infection postoperatively, including 2 (1%) and 11 (6%) patients in the non-IOC and IOC group, respectively ($p = 0.002$). Length of stay was longer in the IOC group [4 (3–5) days vs. 5 (3–8) days; $p < 0.001$]. However, urinary catheterization was not a significant risk factor for prolonged hospital stay [odds ratio (OR) (95% confidence interval (CI) 1.20 (0.71–2.01); 0.484] when adjusted for age, gender, body mass index (BMI), American Society of Anesthesiologists score, diabetes, type of surgical procedure, estimated blood loss, tumor stage, and abdominal postoperative complications including intraabdominal abscess, wound infection and/or dehiscence, small bowel obstruction, and prolonged or recurrent ileus.

DISCUSSION

This study demonstrates that removal of urinary catheter on POD1 is feasible and resulted in the majority of patients voiding spontaneously on POD1. Less than 10% of patients without any predictive factors will experience urinary dysfunction and the need for IOC. IOC affords patients the opportunity to discontinue catheterization as soon as urinary function recovers. Ultimately, 86% of patient left the hospital without the need for ongoing urinary catheterization. This standard practice of removing urinary catheters on POD1 resulted in a very low UTI rate of 3%.

Because postoperative UTI doubles hospitalization cost and is associated with an increase in other postoperative complications and prolonged length of stay, UTI prevention is one of the main priorities of postoperative management.[16–18] The rate of catheter-associated UTIs has also been recently identified as one of the best indicators to differentiate hospitals.[19] Previous series have reported a 6–10% rate of UTI when urinary catheters are removed after POD2.[2,5,6] In our study, standard urinary catheter removal on POD1 was associated with a 3% rate of UTI. Our results are concordant with previous findings demonstrating that the reduction of urinary catheterization duration by 2 days decreased the rate of UTI in hospitalized patients by 50%.[11,20] This suggests that urinary catheter removal on POD1 followed by IOC in patients with urinary dysfunction may be an efficient urinary catheter management to prevent UTI. The higher rate of UTI observed in the IOC group can be related to the longer duration of urinary catheterization. Duration of urinary catheterization is known to be the main risk factor for healthcare-associated UTI.[20] Patient comorbidities are also a putative cause for the higher UTI rate in the IOC group. Obesity and obstructive urinary disease were risk factors for IOC in the study and are known to be strong predictive factors for healthcare-associated UTI.[21,22]

Following urinary catheter removal on POD1, 41% of patients required IOC. In previous studies, 20–30% of patients were diagnosed with postoperative urinary retention or urinary dysfunction after catheter removal on POD1. One explanation for the higher rate of suspected urinary dysfunction in our study could be the high proportion of APR (32%) as compared with previous studies (6–23%).[4,5,7,8,10] In our study population, APR was a predictive factor for IOC. The other explanation is related to the design of the protocol for urinary catheter management. Need for IOC was determined by inability to void within the 6 h following indwelling catheter removal. This policy regarding IOC potentially led to overestimation of urinary dysfunction and overtreatment of patients who did not void. The main purpose of this protocol was to avoid acute urinary retention and immediately begin self IOC teaching to prepare patients and families for discharge.

Several studies had previously investigated predictive factors associated with postoperative urinary dysfunction following rectal resection.[2,4,5,7,8,10,23] Our results confirm that male gender, APR, and previous history of obstructive urinary disease predict the need for IOC.[2,4,5,7,8,10] Importantly, this study highlights two predictive factors of IOC that have not been previously described: obesity and metastatic disease. Rectal surgery in obese patients is known to be challenging.[24] The higher rate of urinary dysfunction in these patients could be due to increased manipulation of the bladder and dissection challenges during TME. The association between urinary dysfunction and metastatic status may be related to neoadjuvant chemotherapy. All patients with metastatic disease in our study received 4–6 months of preoperative chemotherapy, which included oxaliplatin. Neoadjuvant chemoradiation for nonmetastatic patients did not include oxaliplatin and was not associated with postoperative IOC. Urinary dysfunction has rarely been described in patients treated with oxaliplatin.[25] However, the induced neurotoxicity could predispose patients to postoperative urinary dysfunction.

The rate of urinary catheterization at dismissal in our cohort was 14% after median length of stay of 5 days. The rate of catheterization at dismissal has not been well reported in previous studies. Bouchet-Doumencq et al. noted that 6% of men hospitalized for at least 6 days were discharged with the need for ongoing suprapubic or transurethral urinary decompression following proctectomy.[2] In our study, where suprapubic catheters were never used and urinary catheter was removed on POD1, the median length of stay was shorter. Moreover, postoperative urinary dysfunction was not an independent risk factor for prolonged hospital stay. These results contradict previous studies which demonstrated that postoperative urinary retention was associated with increased length of stay.[26] This could be explained by our protocol of teaching IOC starting on POD1 in patients with urinary dysfunction. Within this system of care, when patients need IOC at dismissal, they are already prepared to do it alone and their discharge is not delayed by the necessity to teach IOC.

Predictive factors for IOC on POD1 also predict the risk of IOC within the first five postoperative days. These data provide important predictive information for patients about the expected duration of IOC. Surgical teams can use this information to preoperatively predict the risk for IOC based on clinical criteria, and potentially adapt individual management. Fifteen percent of patients without any predictive factor of IOC were at low risk for urinary dysfunction following catheter removal on POD1, with less than 10% requiring IOC for urinary dysfunction on POD1, and only 2% on POD5. However, patients with at least two risk factors were at high risk of IOC within the first five postoperative days. These patients should be informed that at least 50% will require IOC within the postoperative course and at least 20% will still perform IOC on POD5. In patients with high risk of prolonged urinary dysfunction, an indwelling urinary catheter could be an alternative to IOC. However, indwelling catheter is associated with similar rates of UTI when compared with IOC and hinders patient mobility. For these reasons, IOC was used as soon as POD1 in all patients experiencing urinary dysfunction in this study.

This study was limited by its retrospective design. This would not have impacted the rate of urinary dysfunction, as this was systematically recorded during the hospital stay. However, this could have underestimated the UTI rate and

overestimated the duration of catheterization in patients dismissed with IOC. As the urinary catheter was systematically removed between 6 and 8 AM, the time from end of surgery to catheter removal could vary from 12 to 19 h. This could have biased the rate of urinary dysfunction on POD1. Another limit is the absence of preoperative urinary function evaluation. Although we preoperatively asked all patients about obstructive urinary symptoms, we did not utilize validated urinary function questionnaires such as I-PSS for men[27] or ICIQ-FLUTS[28] for women. The advantages of urinary catheter removal on POD1 have to be confirmed in a comparative study including control patients managed with catheter removal after POD1.

CONCLUSIONS

Removal of urinary catheter on POD1 followed by systematic IOC in patients with urinary dysfunction was feasible in patients undergoing rectal resection for cancer. This management avoided acute urinary retention and resulted in 86% of patients dismissed without urinary catheterization. The risk of urinary dysfunction during the early postoperative period can be predicted by preoperative factors including male gender, obesity, history of obstructive urinary disease, metastatic disease, and need for APR resection.

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