BACKGROUND: This article outlines our current perioperative management of patients undergoing cystectomy and urinary diversion using advancements in perioperative care to allow for early institution of an oral diet and early hospital discharge.

STUDY DESIGN: Three hundred sixty-two consecutive patients underwent radical cystectomy and urinary diversion with curative intent (2001 through 2008). Each underwent a perioperative care plan (“fast track” program). Throughout our experience, evidence-based modifications to this program were instituted. We analyzed the impact of these modifications and report the outcomes with the most recent 100 patients in whom no additional modification has been used.

RESULTS: Mean age of patients is 66.3 years, with 44% of the patients older than age 70 years and 12% older than age 80 years. We found no detrimental effects to immediate removal of the orogastric tube at the end of the procedure, but found a beneficial effect of empiric metoclopramide use, with lower rates of nausea and vomiting. Perioperative antibiotic coverage has been reduced to 24 hours as per American Urological Association guidelines. Gum-chewing has also been shown to be of benefit with regard to a more rapid recovery of bowel function. Use of nonnarcotic analgesics (eg, ketorolac) has also been central in the pathway. Finally, early institution of an oral diet has been an original and central component to our fast track program.

CONCLUSIONS: Successful application of a fast track program has been applied to our patients undergoing radical cystectomy and urinary diversion, with the potential to use evidence-based modifications to reduce morbidity and improve recovery. (J Am Coll Surg 2010;210:93–99. © 2010 by the American College of Surgeons)
This article describes our experience with widespread application of a clinical care perioperative management program (ie, fast track program) for patients undergoing radical cystectomy and urinary diversion. The plan describes our initial experience, evidence-based modifications to the approach, and the current fast track program used in our cystectomy patient population.

METHODS

In accordance with the principles and practices of the University of North Carolina Institutional Review Board, and in recognition of and compliance with US Health Insurance Portability and Accountability Act of 1996 guidelines, a retrospective chart review was performed that identified 362 patients who had undergone ileal conduit urinary diversion or ileal neobladder after cystectomy for bladder cancer from 2001 through 2008. Based on the success in an initial cohort of 40 patients, all patients in the current case series underwent a prospectively created care plan as described here (see Table 1). Criteria for hospital discharge included tolerance of regular diet, satisfactory pain control with oral agents alone, demonstrated understanding of postoperative expectations and care (eg, ostomy care, activities of daily living), provision of home healthcare if needed, and expressed comfort with discharge by primary care team and patient and family. In addition, pelvic drains were removed before discharge if not otherwise contraindicated.

After discharge, patients typically return to our facility in an outpatient setting for interval history and physical examination (including wound check), removal of ureteral stents (7 to 10 days) and, in the case of neobladders, cystogram urethral catheter removal (18 to 21 days). Modifications to the original program include:

1. **Outpatient bowel preparation.** Throughout our modern experience, we have used a mechanical bowel preparation consisting of sodium phosphate solution. There have been concerns recently about potential side effects and the toxicity of sodium phosphate solutions and, consequently, we have changed this preparation to include a single 8-oz bottle of magnesium citrate solution.

2. **Nasogastric (NG) tube management.** Our initial program included early NG tube removal on postoperative day 1, combined with metoclopramide, based on the reports of Donat and colleagues, who showed that the combination of metoclopramide in early NG tube removal not only hastened the return of bowel function but also reduced complications of atelectasis that can be associated with prolonged NG intubation. We had found no added benefit of leaving the NG tube even overnight and now routinely employ an orogastric tube intraoperatively, which is removed at the end of the case. This modification was instituted after the 60th case and has continued to the present.

3. **Use of prokinetic agents (eg, metoclopramide).** To understand and evaluate the effects of metoclopramide, we performed a prospective analysis in which metoclopramide was removed in 40 consecutive patients (see Table 2) beginning with patient no. 112. Although we found no increased rate of ileus without metoclopramide, we did find higher rate of nausea and vomiting (12% versus 3%). Consequently, metoclopramide was re instituted into our clinical care program with patient no. 152.

4. **Use of chewing gum.** Recent studies in the colorectal surgery literature have demonstrated the potential benefit of chewing gum to reduce postoperative ileus and enhance return of bowel function in patients undergo-

<table>
<thead>
<tr>
<th>Table 1. Cystectomy Fast Track Program</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preoperative</strong></td>
</tr>
<tr>
<td>Counseling/expectations</td>
</tr>
<tr>
<td>Outpatient bowel preparation (day before operation)</td>
</tr>
<tr>
<td>Magnesium citrate solution, 1 bottle (8 oz)</td>
</tr>
<tr>
<td>Fleets enema</td>
</tr>
<tr>
<td>Clear liquid diet</td>
</tr>
<tr>
<td><strong>Surgical</strong></td>
</tr>
<tr>
<td>DVT prophylaxis with TED hose and sequential compression devices</td>
</tr>
<tr>
<td>Perioperative antibiotics (2nd or 3rd-generation cephalosporin) for 24 hours</td>
</tr>
<tr>
<td>Removal of orogastric tube at end of procedure</td>
</tr>
<tr>
<td><strong>Postoperative</strong></td>
</tr>
<tr>
<td>DVT prophylaxis with ambulation, TED, and SCDs, and use of subcutaneous heparin (high-risk patients)</td>
</tr>
<tr>
<td>Gastrointestinal ulcer prophylaxis with an H2 blocking agent</td>
</tr>
<tr>
<td>Prokinetic agents (eg, metoclopramide 10 mg IV every 8 hours for 48 hours)</td>
</tr>
<tr>
<td>Nonnarcotic analgesics (eg, ketorolac 30 mg IV every 6 hours for 48 hours, convert to celecoxib 200 mg twice a day if no contraindications)*</td>
</tr>
<tr>
<td><strong>Supplemental pain management with PCA (typically MSO4) converting to oral agents (typically oxycodone/APAP) on POD 2</strong></td>
</tr>
<tr>
<td><strong>Early ambulation</strong></td>
</tr>
<tr>
<td>Fast track diet (advanced irrespective of bowel function†)</td>
</tr>
<tr>
<td>POD 1, chewing gum initiated (ad lib), otherwise NPO</td>
</tr>
<tr>
<td>POD 2, clear liquids; 8 oz per 8 hours</td>
</tr>
<tr>
<td>POD 3, unrestricted clear liquids</td>
</tr>
<tr>
<td>POD 4, regular diet</td>
</tr>
</tbody>
</table>

* Dose adjusted to age and renal function.
† Advanced irrespective of presence of flatus or bowel movement unless patient experiencing nausea or emesis.

APAP, acetaminophen; DVT, deep venous thrombosis; NPO, nothing by mouth; PCA, patient-controlled anesthesia; POD, postoperative day; SCD, sequential compression devices; TED, thromboembolic deterrent.
ing gastrointestinal operations.\textsuperscript{13-15} We prospectively analyzed the potential benefits of chewing gum into our cystectomy population by starting patients on chewing gum on postoperative day 1 and found that those receiving gum demonstrated substantial reductions in time to flatus and bowel movement after cystectomy, and this intervention was simple and well-tolerated.\textsuperscript{16} Consequently, beginning with patient no. 212, we have included gum-chewing on postoperative day 1 throughout the hospital course.

5. Perioperative antibiotic strategy. Our clinical care pathway had included empiric use of perioperative antibiotics initiated at the time of operation and continued for a total of 48 hours postoperatively. A recent American Urological Association best practice policy statement has recommended the use of only 24 hours of perioperative antibiotics for cases such as cystectomy.\textsuperscript{17} Consequently, based on these recommendations, our pathway has been modified to include 24 hours of perioperative antibiotics beginning just before skin incision. We typically employ a 2nd- or 3rd-generation cephalosporin. This modification was initiated with patient no. 263.

Analysis of outcomes
Outcomes based on several modifications (described here), including use of metoclopramide and chewing gum, are reported and compared with previous case series before the modification. For example, the case series of 40 patients without metoclopramide was compared with the previous 40 patients in whom the medication was empirically used as part of the pathway. Descriptive and comparative results are reported. A similar comparison is reported to analyze outcomes with and without chewing gum.

The most recent 100 patients constitute a consecutive series of patients in which there has been no additional modification to the program and represents our current clinical care pathway. Description of peri- and postoperative outcomes in these most recent 100 patients are reported, including time to flatus and time to bowel movement (recorded as postoperative day); time to hospital discharge (recorded as postoperative day); and complications (using the Clavien system), including those occurring during hospitalization and during the first 30 days after discharge and including all readmissions.\textsuperscript{18} Comparisons were made using Student’s\textsuperscript{t} test for continuous variables and chi-square analysis for categorical measures. Statistical analysis was performed using the SAS v.9 system (SAS Institute).

RESULTS
The care plan was successfully employed in all patients regardless of previous therapies, age, cancer stage, or other comorbidities. Table 3 shows the demographic and clinical characteristics of the entire cohort. Mean age was 66.3 years, and 44% of the patients were older than age 70 years and 12% were older than age 80 years.

Table 2 demonstrates the outcomes in a sequential case series of 80 patients undergoing cystectomy without (n = 40) and with (n = 40) use of postoperative metoclopramide. Although there were no significant differences between the two groups with regard to return of bowel function, time to discharge, or rate of ileus, patients receiving metoclopramide had a lower rate of nausea and vomiting (3% versus 12%; p = 0.01) and trended toward a lower rate of gastrointestinal complications (19% versus 31%; p = 0.07). Because of these differences, empiric metoclopramide treatment (10 mg IV every 8 hours for 48 hours

### Table 2. Impact of Empiric Metoclopramide Treatment after Cystectomy

<table>
<thead>
<tr>
<th></th>
<th>Age, y</th>
<th>Regular diet, n</th>
<th>LOS, d</th>
<th>GI complications, %</th>
<th>Ileus, %</th>
<th>Nausea/vomiting, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>With metoclopramide (n = 40)</td>
<td>65.8</td>
<td>3.9</td>
<td>5.1</td>
<td>19</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Without metoclopramide (n = 40)</td>
<td>66.7</td>
<td>3.9</td>
<td>5.6</td>
<td>31</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>

p Value 0.642 0.821 0.330 0.072 0.419 0.011

GI, gastrointestinal; LOS, length of stay.

### Table 3. Demographic and Operative Outcomes for Entire Case Series (n = 362)

<table>
<thead>
<tr>
<th>Demographics and operative outcomes</th>
<th>Mean age, y</th>
<th>Gender, n (%)</th>
<th>Race, n (%)</th>
<th>Mean BMI</th>
<th>Mean EBL, mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>66.3</td>
<td>Male</td>
<td>Female</td>
<td>27.6</td>
<td>499</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td>269 (74)</td>
<td>93 (26)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td>Caucasian</td>
<td>African American</td>
<td>Other</td>
<td>308 (85)</td>
</tr>
<tr>
<td>Mean BMI</td>
<td></td>
<td>27.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean EBL, mL</td>
<td></td>
<td>499</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diversion, n (%)

<table>
<thead>
<tr>
<th>Diversion, n (%)</th>
<th>Conduit</th>
<th>Neobladder</th>
<th>None*</th>
</tr>
</thead>
<tbody>
<tr>
<td>231 (64)</td>
<td>129 (36)</td>
<td>2 (&lt;1)</td>
<td></td>
</tr>
</tbody>
</table>

*Patients with end-stage renal disease.

BMI, body mass index (calculated as kg/m\(^2\)); EBL, estimated blood loss.
postoperatively) has been reinstated and maintained as part of the clinical care program since patient no. 152.

Table 4 shows perioperative outcomes in a sequential case series of 102 patients undergoing cystectomy without (n = 51) and with (n = 51) use of chewing gum as part of our fast track program. Time to flatus and time to bowel movement were considerably shorter in the gum-chewing group. In addition, there was a trend toward shorter hospital stay with gum-chewing (p = 0.067). A detailed description of this study has been reported previously.16

Table 5 demonstrates outcomes in the most recent 100 patients representing our current clinical care pathway. These 100 patients represent the most recent consecutive series in which no additional modifications to the program have been instituted. The mean operating room, as for operative characteristics, time was 3.9 hours with 71 patients undergoing an ileal conduit diversion and 29 receiving an orthotopic ileal neobladder with no differences observed based on diversion type. Mean lymph node yield for this patient cohort was 19 (range 6 to 40). A favorable return of bowel function and time to discharge observed for this most recent series, with almost 80% of patients being discharged on postoperative day 4 or 5. Forty-five complications occurred in 39 patients, with 16 patients experiencing gastrointestinal complications. Of the 45 complications, 8 were major (defined as Clavien grade 3 or higher) and 37 were minor (Clavien grade 1 or 2) (see Table 6). The most common reasons for readmission (12%) included urinary tract infection (3%), ileus/nausea/vomiting (2%), deep venous thrombosis (2%), internal/omentum herniation (1%), dehiscence (1%), bradycardia (1%), dehydration (1%), and newly diagnosed chronic myelogenous leukemia (1%).

**DISCUSSION**

Clinical pathways are an important and potentially powerful tool that can have beneficial effects that include improvement in quality of care, cost reduction, transparency of treatment, and staff satisfaction with benefits of training and education.6-10,19,21 Implementation of clinical care pathways and evidence-based fast track programs have been successfully employed in a wide variety of surgical procedures, ranging from colorectal operations to hepatobiliary procedures to cardiothoracic operations, to name just a few.6-10 To date, application to urologic procedures has been rather limited.

The group at Vanderbilt University has been an innovator with development and application of collaborative clinical care pathways in urologic oncology. Successful programs with clear benefits to patients and hospitals have

---

**Table 4. Impact of Gum-Chewing on Bowel Function and Hospital Discharge**

<table>
<thead>
<tr>
<th>Group</th>
<th>Age, y</th>
<th>Time to flatus, d</th>
<th>Time to BM, d</th>
<th>LOS, d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>66.5</td>
<td>2.9</td>
<td>3.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Gum-chewing</td>
<td>64.8</td>
<td>2.4</td>
<td>3.2</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>p Value</strong></td>
<td>0.380</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.067</td>
</tr>
</tbody>
</table>

BM, bowel movement; LOS, length of stay.

**Table 5. Outcomes in Most Recent 100 Patients on Current Pathway**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Mean (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y, mean (range)</td>
<td>66.9 (33–86)</td>
</tr>
<tr>
<td>ASA score, mean (range)</td>
<td>2.7 (2–4)</td>
</tr>
<tr>
<td>Mean time to flatus, d</td>
<td>2.2</td>
</tr>
<tr>
<td>Mean time to BM, d</td>
<td>2.9</td>
</tr>
<tr>
<td>Mean time to discharge, d</td>
<td>5.0</td>
</tr>
<tr>
<td>% DC on POD 4/5</td>
<td>79</td>
</tr>
<tr>
<td>Overall complication rate, % of patients</td>
<td>39</td>
</tr>
<tr>
<td>GI complication rate, % of patients</td>
<td>16</td>
</tr>
<tr>
<td>Readmission rate, %</td>
<td>12</td>
</tr>
</tbody>
</table>

ASA, American Society of Anesthesiologists; BM, bowel movement; DC, discharge; GI, gastrointestinal; POD, postoperative day.

**Table 6. Complications in Most Recent 100 Patients**

<table>
<thead>
<tr>
<th>Complications</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major complications</td>
<td></td>
</tr>
<tr>
<td>Fascial dehiscence</td>
<td>2</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>1</td>
</tr>
<tr>
<td>Cardiac ischemia</td>
<td>1</td>
</tr>
<tr>
<td>Death</td>
<td>1</td>
</tr>
<tr>
<td>Internal herniation</td>
<td>1</td>
</tr>
<tr>
<td>Misplaced ureteral stent</td>
<td>1</td>
</tr>
<tr>
<td>Postoperative bleed</td>
<td>1</td>
</tr>
<tr>
<td>Minor complications</td>
<td></td>
</tr>
<tr>
<td>Ileus/nausea/vomiting</td>
<td>12</td>
</tr>
<tr>
<td>UTI</td>
<td>5</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>3</td>
</tr>
<tr>
<td>Atelectasis/desaturation</td>
<td>3</td>
</tr>
<tr>
<td>Altered mental status</td>
<td>2</td>
</tr>
<tr>
<td>DVT</td>
<td>2</td>
</tr>
<tr>
<td>FUO</td>
<td>2</td>
</tr>
<tr>
<td>Urine leak</td>
<td>2</td>
</tr>
<tr>
<td>Acute renal insufficiency</td>
<td>1</td>
</tr>
<tr>
<td><em>Clostridium difficile</em> enterocolitis</td>
<td>1</td>
</tr>
<tr>
<td>Delirium tremens</td>
<td>1</td>
</tr>
<tr>
<td>Dehydration</td>
<td>1</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1</td>
</tr>
</tbody>
</table>

Major complications defined as Clavien grade 3 or higher; minor complications defined as Clavien grade 1 or 2; DVT, deep venous thrombosis; FUO, fever of unknown origin; UTI, urinary tract infection.
been reported in prostatectomy, cystectomy, and even retroperitoneal lymphadenectomy procedures. These authors have demonstrated how such care programs can shorten length of stay, decrease hospital cost, and even improve patient and staff satisfaction. Recently, Chughtai and colleagues also reported on the benefits of fast track open partial nephrectomy for reducing postoperative length of stay without compromising clinical outcomes.

For cystectomy, Maffezzini and colleagues have described the benefits of a perioperative management program for reduction of postoperative ileus in their cystectomy population. In a case series of 107 patients, these authors used a multimodal perioperative program that includes combining parenteral (intravenous) and enteral (via a jejunal cannula) nutrition to help decrease postoperative ileus. Despite such benefits, length of stay remained longer than the current series, potentially because of the impact of their more invasive strategy of nutritional support and perhaps because of societal and economic expectations and differences between this European cohort as compared with the current American series.

We have reported previously on our initial experience with a multimodal perioperative care program that was unique in describing fast track diet advancement regardless of bowel function. Findings from this initial experience demonstrated excellent tolerability of this program, with enhanced recovery of bowel function and early hospital discharge without an increased rate of complications. The current report provides an updated and much larger clinical experience based on this initial report, and the present report describes several important evidence-based modifications to our initial pathway.

One of the first modifications employed was immediate removal of the NG (or typically orogastric) tube at the end of the surgical procedure. The initial experience using both overnight NG tube and metoclopramide was based on the report of Donat and colleagues, which described the potential for early NG tube removal (ie, postoperative day 1) with metoclopramide. These authors demonstrated the potential benefits of early return of bowel function and reduced complications of atelectasis with early NG tube removal. Although this was employed in our initial experience, we subsequently found no added benefit to leaving the NG tube even overnight and now routinely employ an orogastric tube intraoperatively, which is removed at the end of the case. We then evaluated and prospectively analyzed the prospective benefits of metoclopramide itself. Use of metoclopramide, as described here, seemed to reduce rates of nausea and vomiting in our patients (3% versus 12%) and possibly gastrointestinal complications, although no definite effect on postoperative ileus was found. Consequently, metoclopramide has been reinstated in an effort to reduce postoperative nausea and vomiting in our patient population.

Throughout our experience, we used nonnarcotic analgesics (eg, ketorolac) to help in the management of postoperative pain. Laboratory and clinical studies have demonstrated the ability of ketorolac to hasten the return of myoelectrical activity after laparotomy, improving such activity to levels found in nonoperated controls. These findings suggest that the medications can serve in a chemoprotective role to prevent postoperative ileus, independent of influence of narcotic use. In addition, ketorolac has been shown to reduce use of narcotic analgesia in a variety of surgical procedures. Decreased narcotic requirement itself is likely to decrease the incidence of postoperative bowel hypokinesis and the possibility of ileus. Accordingly, we have maintained the use of ketorolac for the initial 48 hours after cystectomy in patients with normal renal function and conversion to oral celecoxib after 48 hours in patients with no allergies or other contraindications.

Use of gum-chewing has also been of benefit to our patients, with more rapid return of flatus and bowel movements. These findings are consistent with findings in the colorectal surgery literature, which have also found benefits to gum-chewing. According to these and other studies, gum-chewing can stimulate bowel motility and decrease incidence of paralytic ileus after gastrointestinal operation, leading to faster time to flatus and bowel movements. We have also reported similar benefits to bowel recovery in a cystectomy patient population. Our findings support outcomes seen in the colorectal surgery literature that gum-chewing might be an easy and inexpensive way to enhance recovery of bowel function because of oral-gastric reflexes under neurohumoral control.

Finally, early institution of an oral diet has been an original and central component to our fast track program. We have found that early institution of the diet has been successful and well-tolerated in all of our patients and has allowed us to provide early advancement of their diet, resulting in a more rapid discharge to home. An early diet protocol has been employed with success in patients undergoing other types of elective small bowel operations and has been similarly successful in our cystectomy patient population, which requires harvesting a segment of distal ileum. We have not encountered undue or excessive problems with diet and tolerance, gastrointestinal dysfunction, or ileus on increased readmission related to this early diet protocol, as shown here. Early institution of an oral diet has had the greatest impact on early discharge from the hospital, and our experience demonstrates that it can be done in a safe manner.

We have previously reported the early success of this
approach in a small cohort of patients. The larger cohort reported here has helped confirm our previous findings, and evaluated and instituted a variety of evidence-based modifications throughout the experience, as our experience with this regimen has grown. We certainly expect ongoing modifications to the current protocol as novel evidence-based studies and approaches are reported and validated from both our own experience and that of others.

There certainly exist important and noteworthy limitations in our current analysis. First, as noted here, the entire experience demonstrates an evolutionary process with important modifications. We have attempted to provide evidence-based justifications for such modifications and have similarly reported our most recent 100 cases in which there have been no such modifications to the clinical care program. Second, the current care program uses a sodium phosphate solution in mechanical bowel preparation. Because of recent concerns about safety with such a solution, we have modified the mechanical preparation to one including a magnesium citrate solution. It is unclear how such a bowel preparation can influence our overall outcomes, although we suspect the replacement of sodium phosphate with magnesium citrate to have a minimal overall impact. The benefits of the mechanical bowel preparation have been questioned in the colorectal surgical literature (ie, versus no bowel preparation at all) and we are currently conducting a prospective study in which no mechanical bowel preparation is used and patients are allowed a regular diet until midnight before the operation. Such ongoing modification and analysis remain an important aspect of clinical care pathways, which provide a ready mechanism by which scientific evidence translates into clinical practice.

Successful application of a fast track program has been applied to our patients undergoing radical cystectomy and urinary diversion. Such a clinical care pathway has the potential to use evidence-based modifications to reduce morbidity and improve recovery with early institution of oral diet and early hospital discharge. Ongoing modifications and analysis of this program remain an important aspect of clinical care pathways that provide a ready mechanism by which scientific evidence translates into clinical practice.

Author Contributions

Study conception and design: Pruthi, Nielsen, Wallen
Acquisition of data: Pruthi, Nielsen, Smith, Nix, Schultz, Wallen
Analysis and interpretation of data: Pruthi, Nielsen, Wallen
Drafting of manuscript: Pruthi, Smith, Wallen
Critical revision: Nielsen, Nix

REFERENCES