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Decreased Length of Stay and Earlier Oral Feeding Associated with Standardized Post-Operative Clinical Care for Total Gastrectomies at a Cancer Center

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Abstract

Introduction—Standardization of post-operative care has been shown to decrease post-operative length of stay.

Methods—In June 2009, we standardized post-operative care for all gastrectomies at our institution. Four years worth of total gastrectomies (two years prior to standardization and two years after standardization) were reviewed to determine the effect standardization had on post-operative care, length of stay, complications, and readmissions.

Results—Between June 2007 and July 2011, 99 patients underwent curative intent open total gastrectomy; 51 patients prior to standardization and 48 patients post standardization. Patients were predominantly male (70%), median age was 63, and median BMI was 26. Standardization of post-operative care was associated with a decrease in median time to beginning both clear liquids and a post-gastrectomy diet, earlier removal of epidural catheters, earlier use of oral pain medication, less time receiving IV fluids, and decreased length of stay (all $p < 0.01$). There was no difference between groups in complication rates, complication severity, diet intolerance, returned to our Urgent care center (UCC), or readmission.

Conclusions—Institution of standardized post-operative orders for total gastrectomy was associated with a significantly shorter length of stay and earlier oral feeding without increasing post-operative complications, UCC visits, or readmissions.

Article Summary

Standardizing post-operative care following total gastrectomy was associated with shortened length of stay without diet intolerance, complications, or readmissions. This report reinforces that early oral feeding is safe following total gastrectomy.

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Keywords

Gastric Cancer; Total Gastrectomy; Surgical Secondary Events; Surgical Adverse Events; Surgical Quality Improvement; Surgical Care standardization

Introduction

Post-operative care of patients undergoing complex gastrointestinal surgical procedures is a multidisciplinary process, requiring multiple health care professionals working to achieve the best outcomes. Standardizing medical care can result in decreased post-operative complications, lower hospital costs, and decreased length of stay in a variety of inpatient and outpatient settings¹, and has repeatedly been shown to be beneficial for patients undergoing colectomy.²⁻⁶

Gastric cancer is one of the leading causes of cancer-related deaths globally. Surgery, which is required for cure, is often combined with chemotherapy in advanced cases. In the United States approximately 30% of all patients undergoing gastrectomy receive a total gastrectomy,⁷ which is performed selectively for tumors at the gastro-esophageal junction, proximal one-third of the stomach, or tumors with diffuse histology regardless of anatomical location.⁸

In 2009, using principles of care we had employed previously, but not uniformly, we standardized the post-operative care for all patients undergoing total gastrectomy at our institution (Table 1). The aim of this study is to describe the changes in post-operative course and care associated with this standardization.

Methods

Following institutional review board approval, we queried our prospectively maintained gastric surgery database for all patients undergoing total gastrectomy between June 2007 and July 2011. We manually reviewed all electronic health records to document time to clear liquid diet (CLD), post-gastrectomy diet (PGD), oral analgesia, removal of the urinary catheter, and length of stay.

Post-operative complications are prospectively graded using our modification of the Clavien-Dindo classification⁹ and classified as minor or major¹⁰. Grades 1 (an event requiring oral medication) and 2 (an event requiring IV medication or a bedside procedure) are considered minor; grades 3 (an event requiring intubation or operative, endoscopic, or radiologic intervention), 4 (an event resulting in prolonged disability or organ resection), and 5 (death) are considered major.

Post-Operative Orders

In June 2009, using principles that had not been uniformly employed previously at our institution, we introduced standardized post-operative orders on all patients undergoing gastrectomy. Patients receive CLD on post-operative day (POD) 1, diet progression as tolerated until they are receiving a PGD, oral analgesia and discontinuation of IV fluids

when they are tolerating oral intake. For this analysis, patients who were given sips of water as opposed to a full CLD were analyzed as if they were NPO until clinical documentation referred to their receiving a CLD. We do not use naso-jejunal drainage tubes, enteral feeding tubes, or peri-anastomotic drains. Patients undergo intra-abdominal imaging or anastomotic imaging only when indicated by a change in their clinical condition.¹¹ All post-operative patients are admitted to a dedicated surgical floor where surgical oncology fellows and attending surgeons, assisted by dedicated nurse practitioners and experienced floor nurses, direct their care. The surgical oncology fellows rotate among surgical services monthly and spend at least two months during their fellowship on services with gastrectomy patients. Prior to discharge, all patients receive detailed instructions on post-operative diet from an in-house nutritionist; patients are discharged when they are tolerating a post-gastrectomy diet and oral pain medication.

All curative intent open total gastrectomies performed within two years of standardization were reviewed to determine the effect standardization had on time to oral feeding, oral pain medication, length of stay, complication number and severity, ER visits, and readmissions. We excluded patients undergoing surgery in June and July of 2009 to allow time for the clinical staff to familiarize themselves with the new orders. Patients were excluded from our analysis if they underwent completion gastrectomy for recurrent gastric cancer, if they underwent a thoracoabdominal surgical approach, or if they underwent a minimally invasive gastrectomy, although these patients also receive this standardized care. Patients who experienced major post-operative complications censored at the date of their complication. For example, a patient made NPO on POD#5 because of an esophago-jejunal anastomotic leak is included in the analysis for their first four days, but not subsequently. Differences between groups (pre-standardization vs post-standardization) were examined using a ranksum test for continuous variables and chi square test for categorical variables; significance was defined as $p < 0.05$, and all statistical analyses were conducted on Stata12 (StataCorp, College Station, TX).

Results

Between June 2007 and July 2011 (excluding June and July 2009), 99 patients underwent curative intent open total gastrectomy. Of these, 51 (52%) were operated on prior to post-operative order standardization in June 2009, the remaining 48 (48%) were operated on subsequent to order standardization. Patients were predominantly male (70%), median BMI was 26 (IQR: 24 – 29), 52% ($n = 51$) received neoadjuvant chemotherapy and 39% ($n = 39$) received adjuvant therapy; patient and pathological characteristics are shown in Table 2.

When compared to patients in the pre-standardization time period, patients who underwent total gastrectomy with standardized post-operative orders had a decrease in median time to beginning a CLD (pre vs post: 3 days [IQR 2–4] vs 2 days [IQR 1–2]; $p < 0.01$) and a PGD (pre vs post: 6 days [IQR 5–7] vs 4 days [IQR 4–5]; $p < 0.01$), earlier removal of epidural catheters (pre vs post: 6 days [IQR 5–7] vs 5 days [IQR 4–5]; $p = 0.03$), earlier use of oral pain medication (pre vs post: 7 days [IQR 5–8] vs 4 days [IQR 4–6]; $p < 0.01$), less time receiving IV fluids (pre vs post: 7 days [IQR 6–9] vs 5 days [IQR 4–8]; $p < 0.01$), and

decreased length of stay (pre vs post: 9 days [IQR 7–12] vs 7 days [IQR 6–9]; $p < 0.01$) (Figure 1).

While patients in the post-standardization cohort began receiving a clear liquid diet earlier, there was no difference in the number of days required to progress from CLD to a PGD (pre vs post: 2 days [IQR 2 – 3] vs 2 days [IQR 2 – 3]; $p = 0.9$), or the frequency of a patient not tolerating either a CLD (pre vs post: 25% vs 17%; $p = 0.3$) or a PGD (18% vs 10%; $p = 0.3$). There was no difference between groups in complication rates, complication severity, the percentage of patients who sought care at our Urgent Care Center (UCC) or readmissions (Table 3). Rates of specific complications, or their severity, did not differ substantially between attending surgeons or from our prior institutional report on total gastrectomy complications.¹²

Surgeon – Specific Outcomes

During the study period, four attending surgeons at our institution performed total gastrectomies (Table 2). Of these, two surgeons accounted for the vast majority of our surgical volume in both time frames (entire cohort: 80 / 99 cases, 81% of all volume; pre-standardization: 37 / 51, 73% of all volume; post-standardization: 43 / 48, 90% of all volume). When analyzed individually, both surgeons experienced decreases in time to clear liquid diet, PGD, oral pain medication, time receiving IV fluids, and length of stay. Time to removal of the epidural catheter and time with an indwelling urinary catheter decreased in one surgeon but not the other (Table 4, Figure 2).

Discussion

Overall, institution of standardized post-operative order sets was associated with significantly earlier initiation of a CLD, a PGD, oral pain medication, decreased time receiving IV fluids, earlier removal of indwelling urinary catheters, and shortened length of stay. There was no increase in patients who could not tolerate their diet (whether clear liquid diet or PGD), complications, visits to our UCC, or readmission. Additionally, following standardization, our two highest volume surgeons both saw significant decreases in these outcomes (Table 3, Figure 2).

We believe that the earlier initiation of oral CLD is the major driver of the observed differences between our groups. Several endpoints in our study (time to oral medication, epidural removal, time receiving IV fluids, and length of stay) require that the patient tolerate a PGD. In our study, earlier initiation of CLD in the post-standardization arm translated to earlier initiation of a PGD (without changing the amount of time it took a patient to progress from CLD to PGD), and therefore patients in the post-standardization arm met these other endpoints earlier. However, because all the changes to our post-operative care occurred concurrently, we are unable to analyze the differential impact of each individual piece.

For this analysis, we censored patients once they suffered major complications. The care for patients who have suffered major complications is individualized care aimed at correcting morbidity and preventing mortality, not the standardized care our order set prescribes. We

did not consider diet intolerance itself to be a complication; it is one of the end points of our study, and it did not increase in patients in the post-standardization group. We excluded all laparoscopic total gastrectomies from this analysis as they were unevenly distributed in the pre and post-standardization time periods (entire cohort: $n = 9$; pre-standardization: $n = 1$; post-standardization $n = 8$) and have previously been shown to significantly decrease length of stay¹³, and we did not analyze patients undergoing subtotal gastrectomies. However, at our institution all patients undergoing gastrectomy, regardless of extent (total or subtotal) or approach (either MIS or open) are treated with this standardized order set.

Over the course of our study, we greatly increased the frequency with which we administer neoadjuvant chemotherapy to our patients. This change in practice patterns is likely responsible for differences in final pathologic T and N stage in our patients (Table 2), where patients in the post-standardization group appear to be somewhat downstaged compared to the pre-standardization cohort. We have previously shown that the administration of neoadjuvant chemotherapy was not associated with increased rates of esophago-jejunal anastomotic leak¹², so it is unlikely that this change in pre-operative practice pattern is responsible for the results reported in this study.

Several recent publications^{14–19} have described single institutional experiences with care pathways for gastric surgery patients. With the exception of a single report on total gastrectomies that showed a high rate of non compliance from clinical care pathways¹⁸, most reports describe decreases in length of stay following institution of standardized post-operative care. A recently published systemic review and meta-analysis synthesized these results, finding that early post-operative feeding is associated with a shorter length of stay without an increase in clinically relevant complications.²⁰ These various approaches all mirror ours as well as the gastric specific recommendations from the Recovery After Surgery (ERAS) Society.²¹ A common thread in efforts to decrease post-operative length of stay following gastrointestinal surgery is early post-operative feeding, although not all groups aim to initiate oral feeding on POD #1. In our study, there was no difference in the time interval between receiving a CLD and later receiving a PGD.

In 2008, Lassen's group published a randomized trial comparing early oral feeding to enteral nutrition in patients who underwent major upper gastrointestinal tract surgery.²² Though Lassen's study, which included 77 total gastrectomies, was not the first study to investigate oral feeding following upper GI surgery it definitively answered that early oral feeding is safe in patients undergoing upper gastrointestinal tract surgery, and led to calls to change practice for these patients.²³

Our study has several limitations. In reviewing clinical documentation, we were able to identify when a patient did not tolerate their diet only when their diet was changed (from CLD to NPO or PGD to either CLD or NPO), but we were unable to tell if a patient's diet intolerance was addressed by simply not advancing their diet. Additionally, though all residents and fellows are aware that patients should receive a CLD on POD #1, the majority of patients did not begin receiving a CLD until POD #2, and we were unable to determine why these patients remained NPO. Unfortunately, our order sets do not require provider

justification for why a patient is not receiving a CLD on POD#1 (or why, later, they are not progressing to a PGD), which prevents an in-depth analysis of why patients did not progress as suggested.

If our findings were the result of an unmeasured change in clinical practice overlapping with order standardization we would expect to observe a trend in early initiation of feeding and decreased length of stay throughout the time frame. However, when the pre-standardization and post-standardization periods are examined individually, the data do not reveal a gradual improvement in clinical outcomes, only a step-wise decrease in the measured endpoints associated with the introduction of our standardized order set.

As with any retrospective study, it is possible that the difference between the pre-standardization and post-standardization cohorts reflect systemic changes in practice that were occurring the same time as the standardization of our orders. However, if this were the case we would have expected to observe a decreases in our clinical endpoints within the pre-standardization and post-standardization time frames. There was no significant change in any measured time-point within either the pre-standardization or post-standardization time frames.

In 2009, we instituted a standardized post-operative order set for all patients at our institution undergoing gastrectomy. Patients receive CLD on POD#1 and are advanced as tolerated to a PGD, early oral pain control, and early discontinuation of IV fluids. We do not routinely utilize intra-abdominal drainage, naso-jejunal drainage, or provide enteral nutrition, and patients only undergo anastomotic imaging when clinically indicated; our approach to these interventions pre-dates this report. Our post-operative order set applies to all gastrectomies, regardless of extent of resection (total or subtotal) or operative approach (minimally invasive or open). This report, which is only on patients who underwent total gastrectomy, highlights that these patients can safely receive an oral diet on their first post-operative day. Unless the patient's individual clinical circumstances warrant deviation from standard post-operative care, concerns about early post-operative feeding of gastrectomy patients are unfounded. Standardizing post-operative care of total gastrectomy patients, with early oral feeding, is safe and is associated with a significant decrease in length of stay.

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Abbreviations

PGD	Post Gastrectomy diet
CLD	Clear liquid diet
NPO	Nil per os
POD	Post-operative day

UCC Urgent Care Center

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Figure 1.
Overall outcomes for entire cohort pre and post-standardization of post-operative care following total gastrectomy.
CLD: Clear liquid diet
PGD: Post-gastrectomy diet

Figure 2.
De-identified attending-specific outcomes for our two busiest surgeons by timeframe.

Table 1

Standard Post-Operative orders for patients undergoing gastrectomy.

Diet	CLD on POD#1 if vital signs and abdominal exam are normal; advanced as tolerated to PGD
IV fluids	Discontinued when tolerating PGD
Pain Control	PCA or PCEA immediately post-operatively, oral analgesia when tolerating PGD
Ambulation	Begins POD #1
Intra-abdominal drainage	Not routinely utilized
Naso-jejunal drainage	Not routinely utilized
Enteral nutrition	Not routinely utilized
Anastomotic Imaging	Only when clinically indicated

CLD: Clear liquid diet

PGD: Post-gastrectomy diet

Table 2

Clinical and pathological demographics on all patients, by timeframe.

	Pre-Standardization (N=51; 52%)	Post-Standardization (N=48; 48%)	p-value
Age (Years)	69 (58, 76)	66 (54, 72)	0.08
BMI (kg/m ²)	27 (24, 29)	26 (24, 29)	0.6
Gender			
Female	11 (22%)	19 (40%)	0.05
Male	40 (78%)	29 (60%)	
Attending Surgeon			
1	21 (41%)	24 (50%)	0.15
2	16 (31%)	19 (40%)	
3	5 (10%)	3 (6.3%)	
4	9 (18%)	2 (4.2%)	
Received Neoadjuvant Chemotherapy	21 (41%)	30 (63%)	0.03
Received Adjuvant Chemotherapy	20 (39%)	19 (40%)	1
T-Stage			
T0 [*]	3 (5.9%)	0 (0%)	0.11
T1	11 (22%)	11 (23%)	
T2	9 (18%)	7 (15%)	
T3	11 (22%)	20 (42%)	
T4	17 (33%)	10 (21%)	
N-Stage			
N0	28 (55%)	23 (48%)	0.06
N1	12 (24%)	9 (19%)	
N2	3 (5.9%)	12 (25%)	
N3	8 (16%)	4 (8.3%)	

Continuous variables are expressed as median (IQR) and categorical variables as N (%).

^{*} All patients received neoadjuvant chemotherapy and had a complete pathological response.

Table 3

Post-operative clinical course by timeframe.

	Pre-Standardization (N=51; 52%)	Post-Standardization (N=48; 48%)	p-value
Time to CLD (days) *	4 (3, 5)	2 (1, 2)	<0.01
Did not tolerate CLD	11 (23%)	7 (15%)	0.3
Time to PGD (days) *	6 (5, 7)	4 (3, 5)	<0.01
Did not tolerate PGD	6 (14%)	4 (9.3%)	0.5
Time from Clears to PGD (days) *	2 (2, 3)	2 (2, 3)	0.9
Time to PO pain medication (days)	6 (5, 7)	4 (4, 5)	<0.01
Time to IVL (days) *	7 (5, 8)	5 (4, 6)	<0.01
Time to Epidural removal (days) †	6 (5, 7)	4 (4, 5)	<0.01
Time to Foley removal *	4 (3, 6)	4 (3, 5)	0.12
Foley reinserted	3 (5.9%)	1 (2.1%)	0.3
Length of Stay (days) *	8 (7, 9)	7 (6, 8)	<0.01
Post-operative complication	27 (53%)	25 (52%)	0.9
Maximum inpatient complication			
None	32 (63%)	25 (52%)	0.064
Minor	8 (16%)	17 (35%)	
Major	11 (22%)	6 (13%)	
UCC visit	10 (26%)	6 (15%)	0.2
Any readmission	7 (18%)	4 (10%)	0.3

Continuous variables are expressed as median (IQR) and categorical variables as N (%).

* In patients who had not yet experienced a complication necessitating a change in clinical condition.

† In patients (n = 54) who had an epidural placed pre-operatively

CLD: Clear liquid diet

PGD: Post-gastrectomy diet

IVL: IV lock (cessation of IV hydration)

UCC: MSKCC's Urgent Care Center

Table 4

De-identified attending specific post-operative clinical course by timeframe.

	Attending 1			Attending 2		
	Pre-Standardization (N=21; 47%)	Post-Standardization N=24; 53%	p-value	Pre-Standardization (N=16; 46%)	Post-Standardization (N=19; 54%)	p-value
Time to CLD(days) *	3.0 (2.0, 5.0)	1.5 (1.0, 2.0)	<0.01	4.0 (3.0, 5.0)	2.0 (1.0, 3.0)	<0.01
Did not tolerate CLD	13 (25%)	8 (17%)	0.3	13 (25%)	8 (17%)	0.3
Time to PGD (days) *	6.5 (6.0, 8.0)	4.0 (3.0, 5.0)	<0.01	6.0 (5.0, 7.0)	4.0 (3.5, 4.5)	<0.01
Did not tolerate PGD	9 (18%)	5 (10%)	0.3	9 (18%)	5 (10%)	0.3
Time from CLD to PGD (days) *	3 (2, 4)	2 (2, 3)	0.086	2 (2, 3)	2 (2, 3)	0.9
Time to PO meds	7.0 (6.0, 9.0)	4.0 (4.0, 5.0)	<0.01	6.5 (5.0, 7.0)	4.0 (3.5, 5.5)	<0.01
Time to IVL	7.0 (6.0, 10.0)	5.0 (4.0, 6.0)	<0.01	7.0 (6.0, 8.0)	4.0 (4.0, 6.0)	<0.01
Time to Epidural removal (days) †	6.0 (5.0, 7.0)	4.0 (4.0, 5.0)	<0.01	6.0 (5.0, 7.0)	6.0 (4.0, 6.0)	0.4
Time to Foley removal *	6.0 (5.0, 8.0)	4.0 (3.0, 5.0)	<0.01	3.0 (2.0, 4.0)	3.0 (2.0, 4.0)	0.9
Foley reinserted	3 (5.9%)	1 (2.1%)	0.3	3 (5.9%)	1 (2.1%)	0.3
Length of Stay (days) *	10.0 (8.0, 11.0)	7.0 (6.0, 8.0)	<0.01	8.0 (7.0, 8.0)	6.5 (6.0, 7.0)	0.021

Continuous variables are expressed as median (IQR) and categorical variables as N (%).

* In patients who had not yet experienced a complication necessitating a change in clinical condition.

† In patients who had an epidural placed pre-operatively

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