Demonstrating the Benefits of Transversus Abdominis Plane Blocks on Patient Outcomes in Laparoscopic Colorectal Surgery: Review of 200 Consecutive Cases

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BACKGROUND: Quality improvement in colorectal surgery (CRS) requires implementation of tools to improve patient and financial outcomes, and assessment of results. Our objective was to evaluate the durability of transversus abdominis plane (TAP) blocks and a standardized enhanced recovery protocol (ERP) on a large series of laparoscopic colorectal resections.

STUDY DESIGN: Two hundred consecutive laparoscopic CRS patients received TAP blocks under laparoscopic guidance at the end of their operation. All were managed with a standardized ERP. Demographic, perioperative, and postoperative outcomes variables were analyzed. The main outcomes measures were length of stay (LOS), readmission, reoperation, morbidity, and mortality rates.

RESULTS: Of 200 cases, 194 were elective and 6 emergent. The main diagnosis was colorectal cancer (45%). The mean patient age was 61.2 years, mean body mass index was 29.2 kg/m^2, and the majority (63%) were American Society of Anesthesiologists (ASA) class III. The main procedure performed was a segmental colectomy (64%). Mean operative time was 181 minutes. Nine cases (4.5%) were converted to open. The median LOS was 2 days (range 1 to 8 days). Twenty-one percent were discharged by postoperative day (POD) 1, 41% by POD 2, and 77% by POD 3. By POD 7, 99% were discharged. Twelve percent (n = 24) had complications, and 6.5% (n = 13) were readmitted. There were 3 unplanned reoperations and no mortalities. Comparing the first and second groups of 100 consecutive patients further tested the consistency of the TAP block benefit. With comparable demographics, there were no significant differences in readmission, complication, or reoperation rates over the entire series.

CONCLUSIONS: Adding TAP blocks to an ERP facilitated shorter LOS with low readmission and reoperation rates when compared to previously published series. The effect appears durable and consistent in a large case series. Transversus abdominis plane blocks may be an efficient, cost-effective method for improving laparoscopic CRS results. (J Am Coll Surg 2014;219:1143−1148. © 2014 by the American College of Surgeons)

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Quality improvement in colorectal surgery requires implementation of tools to improve patient and financial outcomes, as well as assessment of results. Length of stay (LOS) has increasingly been a focus for quality improvement measures in health care.[1] Reduced LOS has been associated with more efficient and effective care from reduced resource use.[2] The Agency for Healthcare Research and Quality (AHRQ), National Quality Forum (NQF), University HealthSystem Consortium (UHC), and National Surgical Quality Improvement Program (NSQIP) all endorse length of stay as a simple resource use measure, a variable that captures indicators of the

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Abbreviations and Acronyms
CRS = colorectal surgery
ERP = enhanced recovery protocol
LOS = length of stay
POD = postoperative day
TAP = transversus abdominis plane

cost and efficiency in health care delivery.[3] Proven practices already established to safely reduce LOS include laparoscopic technique combined with an enhanced recovery pathway (ERP).[4-11] A key component of the ERP is opioid-sparing pain control to prevent symptoms of nausea, vomiting, respiratory depression, immobility, and the associated prolonged postoperative ileus.[7,12]

To reduce the use of opioids, transversus abdominis plane (TAP) blocks have been implemented for postoperative analgesia after abdominal surgery. Recent reports of TAP blocks have described early reductions in pain and narcotic use.[13-18] However, few reports focus on the effects on LOS and patient outcomes. A previous case-matched series from our institution shows TAP blocks have been effective for significantly reducing early postoperative pain and length of stay, and improving short-term outcomes.[19] Here we present the largest series to date, assessing the effects of TAP blocks with laparoscopic abdominal surgery and an established ERP over several years to assess the durability of this addition to our previously optimized ERP, and ensure the effects were consistent over a longer time period, and not something that faded over time.

Our objective was to demonstrate the benefits in short-term patient outcomes using TAP blocks and a standardized ERP in a large series. Our hypothesis was the addition of TAP blocks to laparoscopic abdominal surgery and an ERP improves short-term patient outcomes.

METHODS

After obtaining IRB approval and informed consent, we identified 200 consecutive patients who underwent a laparoscopic colorectal resection with a TAP block from a prospectively maintained departmental database between July 2011 and 2013. A single surgeon performed all cases. Patients were identified by CPT codes and considered for evaluation if they received a TAP block intraoperatively. Patients under 18 years of age, patients with incomplete medical records, patients who underwent loop stoma closures, and nonresection cases were excluded from the analysis. All patients were managed postoperatively with a standardized ERP and discharge criteria that incorporate components of pre- and postoperative patient information, preservation of gastrointestinal function, avoiding organ dysfunction, active pain control, and promoting patient autonomy. Our pathway has been refined since 2000, and outcomes have been previously reported.[9,20-22]

Our method for transversus abdominis plane blocks with the use of laparoscopy has been previously described[23] Under direct laparoscopic visualization, a Braun Stimuplex A insulated needle with 30 mL of 0.25% Marcaine (Hospira) was passed through the skin at the midaxillary line, midway between the iliac crest and the costal margin. The needle was inserted further until 2 distinct "pops" were felt, confirming the correct needle position between the internal oblique and transversus abdominis muscle fascia. The laparoscope confirms a bulge, verifying the anesthetic was covered by the transversus abdominis muscle. The procedure is performed at a second injection site on the same side and bilaterally, injecting 7.5 mL at each site. The total cost of the block is $14.37 (needle, $11.00; syringe, $0.07; vial of 0.5% bupivacaine, $3.00). Placement takes approximately 2 minutes, and there is essentially no learning curve with the combined tactile sensation and direct visualization.

Demographic, perioperative procedural, and short-term outcomes data were examined. Data fields collected included age, sex, BMI, American Society of Anesthesiologists (ASA) class, operative type (emergent/elective), operative procedure, operative time, blood loss, transfusion required, ICU required, hospital length of stay, discharge disposition, and postoperative complications, readmission, reoperations, and mortality. Complications were graded using the Clavien-Dindo Classification.[24] Postoperative ileus was defined as lack of tolerance of oral diet or absence of stool by postoperative day 3.[25] Readmissions were considered within 30 days of patient discharge. The main outcomes measures were LOS, readmission, reoperation, morbidity, and mortality rates.

Table 1. Indications for Operation

Indications for operation	n	%
Colon cancer	52	26
Rectal cancer	38	19
Diverticulitis	34	17
Polyp	30	15
Inflammatory bowel disease	29	15
Other*	11	6
Prolapse	3	1
Volvulus	3	1
Total	200	100

*Other includes carcinoid (n = 2), abdominal pain (n = 2), small bowel mass (n = 2), dysmotility (n = 2), collagenous colitis (n = 1), presacral cyst (n = 1), parastomal hernia (n = 1).

Descriptive statistics were performed to analyze the group as a whole. Two groups were created from the population—the first consecutive 100 patients and the second consecutive 100 patients—to evaluate the durability of the TAP block over time. To compare the first and second consecutive 100 TAP patients, paired *t*-tests, chi-square analysis, and Fisher's exact tests were performed, as appropriate. Statistical significance was defined at $\alpha < 0.05$.

RESULTS

Of the 200 cases, 194 were elective and 6 emergent. The main indications for operation were colon cancer (26%), rectal cancer (19%), and diverticulitis (17%) (Table 1). The mean patient age was 61.2 years and 56% were female. The mean BMI was 29.2 kg/m^2 (SD 6.3 kg/m^2) and the majority (63%) were ASA class III. Thirty-five percent of patients had previous abdominal surgery (Table 2).

The main procedures performed were segmental colectomy (64%) and low anterior resection (25%) (Table 3). The mean operative time was 181 minutes and mean intraoperative blood loss was 54 mL. Nine cases (4.5%) were converted to open. The reasons for conversion were adhesions (n = 3), bleeding (n = 3), narrow pelvis/bulky tumor (n = 2), and obesity (n = 1). The mean and median LOS were 2.6 days (SD 1.5 days) and 2 days (range 1 to 8 days), respectively. Twenty-one percent of patients were discharged by postoperative day (POD) 1, 41% by POD 2, and 77% by POD 3. By POD 7, 99% of patients were discharged (Table 4).

Table 2. Patient Demographic and Outcomes Data

Patient demographic and outcomes data	n	% or (SD)
Sample size	200	
Mean age, y (SD)	61.2	(16.2)
Mean BMI, kg/m^2 (SD)	29.2	(6.3)
ASA Class	60	30
1	1	1
2	60	30
3	126	63
4	13	7
Previous abdominal surgery	70	35
Mean operative time, min (SD)	181.4	(80.5)
Mean blood loss, mL (SD)	54.1	(90.3)
ICU stay required, n	4	2
Postoperative complications, n	24	12
Mean LOS, d (SD)	2.6	(1.5)
Median LOS, d (range)	2	(1–8)
Readmissions*	13	6.5
Unplanned reoperations*	3	1.5

*Readmissions and reoperations considered 30 days from the discharge date.

Table 3. Operative Procedure Performed with Transversus Abdominis Plane Block

Operative procedure performed	n	%
Segmental colectomy	127	64
Low anterior resection	50	25
Ileoanal anastomosis	5	3
Abdominoperineal resection	4	2
Combined laparoscopic and endoscopic resection	4	2
Small bowel resection	4	2
Prolapse repair with resection	3	2
Total proctocolectomy	2	1
Hernia repair	1	1
Total	200	100

Almost all patients (97.5%) were discharged home without the need for temporary nursing.

Twenty-four patients had postoperative complications (12%). The main complication was postoperative ileus (10 of 24, 42%). Most complications were Clavien-Dindo class 1 (Table 5). The readmission rate was 6.5% (n = 13). There were 3 unplanned reoperations (1.5%) and no mortalities.

Comparing the first and second groups of 100 consecutive patients in the series further tested the durability of the TAP block. The patient groups were comparable in demographic data, indications for operation, and procedure performed. In evaluating outcomes, there were no significant differences in readmission, complication, and reoperation rates over the entire series (Table 6).

DISCUSSION

With rising health care costs and increasing pressure to reduce health care use, safely reducing postoperative length of stay and readmission rates have become a priority. In this study, we found that the addition of TAP blocks to laparoscopic abdominal surgery with a well-established ERP facilitated consistent short overall hospital lengths of stay, with low readmission, reoperation, morbidity, and no mortality. In addition, our study was the largest, longest running series in the current literature,

Table 4. Day of Discharge Distribution

Day of discharge	n	%
POD 1	42	21
POD 2	72	36
POD 3	40	20
POD 4–7	44	22
POD > 7	2	1
Total	200	100

POD, postoperative day.

Table 5. Postoperative Complications by Type and Clavien-Dindo Classification

Postoperative complications	n	%
Detail		
Postoperative ileus	10	42
Anastomotic/lower gastrointestinal bleed	7	29
Urinary tract infection	2	8
Dehydration	1	4
C difficile colitis	1	4
Nerve entrapment by suture	1	4
Wound infection	1	4
Stoma prolapse	1	4
By Clavien-Dindo classification		
1	18	75
2	1	4
3	5	21
Total	24	100

evaluating results over 2 years and 200 patients, which uniquely demonstrates the durability of TAP blocks.

Previous studies have affirmed the benefit of TAP blocks on postoperative opioid use. In evaluating 55 patients after total abdominal hysterectomy randomized to undergo TAP block vs placebo, Carney and colleagues[26] found the TAP block reduced total morphine requirements in the first 48 postoperative hours ($p < 0.001$).[26] In a randomized, controlled, single-blind clinical trial evaluating the analgesic efficacy of TAP blocks during the first 48 postoperative hours after abdominal surgery, Sharma and associates[27] found TAP block had reduced analgesic requirement in 24 ($p < 0.01$) and 48 hours postoperatively ($p < 0.01$).[27] In a nonrandomized trial comparing 40 TAP and patient-controlled analgesia vs 34 patient-controlled analgesia alone in laparoscopic colorectal surgery patients after an ERP, Conaghan and associates[14] found TAP blocks significantly reduced overall postoperative intravenous opiate use ($p = 0.03$). In a randomized controlled trial evaluating the effect of TAP blocks on opioid requirements in patients undergoing laparoscopic colorectal resection, Walter and coworkers[18] found the TAP block group had lower median morphine usage (40 mg vs 60 mg), but similar pain scores to the control group. A recent systematic review of randomized controlled trials evaluating the effects of TAP block in adults undergoing abdominal surgery found significantly reduced opioid use in the TAP block patients at 24 hours ($p = 0.002$) and 48 hours ($p < 0.0001$) postoperatively.[15] In a previous case-matched study from our institution on 35 patients undergoing laparoscopic abdominal surgery, the TAP group required less postoperative narcotics than the control group (31.08 mg vs 85.41 mg; $p = 0.01$).

The reported effects of TAP blocks on patient outcomes have been inconsistent. In the randomized controlled trial performed by Walter and coauthors,[18] the median LOS were similar between the TAP and control groups. In Conaghan and colleagues' nonrandomized trial, the authors found the TAP block group trended toward a shorter LOS (3 vs 4 days), but the results were not statistically significant.[14] Earlier studies from our institution are the only reports that addition of a TAP block to laparoscopic colorectal surgery with an established ERP block significantly reduced LOS ($p < 0.001$).[19,28] Furthermore, previous studies have not focused on the short-term patient benefits with TAP blocks.

In evaluating the short-term outcomes of LOS, readmission, complications, and mortality, we affirmed early reports of short LOS. Our LOS of mean 2.6 days (median 2 days) is shorter than that reported for laparoscopic colorectal surgery in general,[12,29,30] and our own results of 3.7 to 4.1 days in 2 separate consecutive series of 1,000 laparoscopic colon procedures with a standardized ERP.[22,31] In this large series, 57% of patients were safely discharged by POD 2 (21% POD 1; 36% POD 2). This success is similar to results seen in smaller case series from our institution.[19,28] We also demonstrated a low readmission rate (6.5%). In comparison with a recently reported 30-day readmission rate of 11.4% after colorectal surgery, with a median additional cost of almost $9,000 per readmission, our outcomes show substantial improvement in the readmission rate and resulting health care use.[32] In addition, using our protocol for TAP block administration, the operative surgeon requires approximately 2 to 3 minutes of operative time to place the blocks at the conclusion of the procedure. This protocol maximizes the time of the duration of the block without significantly increasing the operative time or costs. This article is also the first to demonstrate the durability and consistency of TAP blocks in such a large number of patients. When assessing the benefits over time, there were no significant differences in the consistently short LOS with low readmission and morbidity rates.

We recognize the limitations of this study. First, it is a retrospective review, subject to the biases of a retrospective study design. The results also represent a single, very skilled laparoscopic surgeon's experience and may not be reproducible. Nonetheless, the results show the opportunity for improving patient outcomes and health care spending using TAP blocks with laparoscopic surgery and an ERP that all colorectal surgeons can work toward.

CONCLUSIONS

In conclusion, adding TAP blocks to a well-implemented ERP facilitated shorter LOS. Even with early discharge, readmission and reoperation rates were low. The durability

Table 6. Comparison of Patient Demographic and Outcomes Data for the First and Second 100 Transversus Abdominis Plane Block Patients

Patient demographic and outcomes data	First 100	Second 100	p Value
n	100	100	
Mean age, y (SD)	60.05 (15.36)	62.73 (17.04)	0.2520
Mean BMI, kg/m^2 (SD)	29.56 (5.22)	28.73 (7.11)	0.7361
ASA Class, n			0.3728
1	—	1	
2	36	24	
3	56	70	
4	8	5	
Previous abdominal operation, n	31	40	0.2370
Indication for operation, n			
Colon cancer	28	24	
Rectal cancer	20	18	
Diverticulitis	15	19	
Polyp	13	17	
Inflammatory bowel disease	15	14	
Other	7	4	
Volvulus	1	2	
Prolapse	1	2	
Mean operative time, min (SD)	182 (81.13)	182 (80.10)	0.8658
Operation performed, n			
Abdominoperineal resection	1	3	
Combined laparoscopic and endoscopic resection	2	2	
Ileoanal anastomosis	3	2	
Low anterior resection	30	20	
Segmental colectomy	62	65	
Hernia repair	1		
Prolapse repair with resection		3	
Small bowel resection	1	3	
Total proctocolectomy		2	
Mean blood loss, mL (SD)	62 (103.96)	47 (75.66)	0.2543
Count of ICU stay, days	2	3	1.00
Mean LOS (SD)	2.48 (1.50)	2.86 (1.54)	0.0660
Median LOS (range)	2 (1–8)	2 (1–8)	
Postoperative complications, n	9	15	0.2764
Readmissions, 30 days, n	3	10	0.0818
Unplanned reoperation, 30 days, n	—	3	0.2462

of the procedure was demonstrated with the large series over a 2-year period. Using TAP blocks may be an efficient and cost effective method for improving results after laparoscopic colorectal surgery. With the proven benefits, future study can evaluate the role of different anesthetics and extended duration agents in TAP blocks.

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