Surgery 166 (2019) 849–853

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Hernia

Presented at the Academic Surgical Congress 2019

Enhanced recovery after surgery pathway for patients undergoing abdominal wall reconstruction

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ARTICLE INFO

Article history:
Accepted 19 May 2019
Available online 28 June 2019

ABSTRACT

Background: Pathways of enhanced recovery after surgery represent a standardized, multimodal approach to postoperative care with the goal of accelerating recovery without increasing morbidity. We hypothesized that implementation of an enhanced recovery after surgery pathway for abdominal wall reconstruction would result in a decreased duration of stay.

Methods: We compared 100 historic controls to 100 consecutive patients undergoing abdominal wall reconstruction with use of a newly implemented, enhanced recovery after surgery pathway to detect a difference in duration of stay of 1 day. Groups were compared on demographics and clinical characteristics using χ^2, Fisher exact, Mann-Whitney *U* test, and 2 sample *t* tests as appropriate for the data.

Results: There was no change in duration of stay with the enhanced recovery after surgery protocol (median 5 vs 5 days, $P = .78$). There was no difference in time to regular diet (median 3 vs 3 days, $P = .14$). There was a trend toward decreased time epidurals or patient-controlled analgesia used (median 3 vs 3 day, $P = .01$). There was no increase in readmission rates. In a subgroup analysis, factors associated with a duration of stay <4 days were hernia width 9.5 ± 7.2 cm ($P = .009$), operative time 2.5 ± 0.9 hours ($P = .001$), and preoperative quality-of-life scores (HerQles) 59.5 ± 11.7 ($P = .008$).

Conclusion: Our enhanced recovery after surgery study group did not show a decrease in duration of stay. Although smaller hernia defects, lesser operative times, and better baseline quality-of-life scores were associated with shorter duration of stay, the benefits of enhanced recovery after surgery seem limited in patients with the more complex hernia repairs.

Introduction

Pathways of enhanced recovery after surgery (ERAS) represent a multimodal approach to postoperative care with the goal of improved recovery, outcomes, and value.[1] The use of ERAS protocols in both open and laparoscopic colorectal surgery has been studied extensively, with improvements in perioperative outcomes and decreases in length of stay (LOS).[2–6] ERAS protocols have since been expanded to other specialties, including orthopedic, genitourinary, and multiple organ-based operations in gastrointestinal surgery.[7]

Protocols have also been developed for ventral hernia repair, demonstrating shorter times to regular diet and a decrease in LOS by >2 days in some studies.[8–11] Although these studies suggest a benefit of enhanced recovery pathways for patients undergoing ventral hernia repair, the utility of ERAS pathways in complex abdominal wall reconstruction (AWR) with larger defects requiring separation of components remains largely unknown. We hypothesized that implementation of an ERAS pathway for AWR would result in faster recovery and decreased LOS.

Materials and Methods

After reviewing the literature on ERAS pathways, a core group of hernia surgeons agreed to follow a universal protocol for patients undergoing elective AWR at Cleveland Clinic, which is summarized in Table I. A comparison between the existing postoperative care and the ERAS pathway is shown in Table II. Patients undergoing repairs of midline, incisional, or flank hernias were included in the study. All Centers for Disease Control and Prevention wound classes were included. Patients undergoing parastomal hernia repairs,

Presented as an oral presentation at the Academic Surgical Congress, Houston, TX, February 6, 2019.

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https://doi.org/10.1016/j.surg.2019.05.023
0039-6060/

Table I
ERAS pathway

POD	Pain control	Diet and bowel regimen	IV fluids	Lines/drains
POD0	Intraoperative TAP blocks PCA	NPO in PACU Clears on RNF	Limit intraoperative IVF MIVF@75	Foley No NGT drains
POD1	Toradol q 6 h (at discretion of surgeon) Scheduled Tylenol and gabapentin	Clears Milk of mag 30 mL BID Colace BID	Decrease MIVF (if good UOP and tolerating PO)	Foley No NGT Drains per surgeon
POD2	Add oxycodone (if tolerating PO) Wean PCA settings as tolerated	Regular (if tolerating clears) Continue bowel regimen	Decrease MIVF (if good UOP and tolerating PO)	d/c Foley Drains per surgeon
POD3	Plan to d/c PCA and transition to PO w/IV for breakthrough pain	Regular diet Continue bowel regimen	HLIV (if tolerating PO)	No Foley or NGT Drains per surgeon
POD4-5	Goal to discharge by POD4 (afternoon discharge) vs POD5 if doing well			

NGT, nasogastric tube; *PACU*, post anesthesia care unit; *MIVF*, maintenance intravenous fluids; *HLIV*, heplock intravenous fluids; *NPO*, nil per os; *RNF*, regular nursing floor; *IVF*, intravenous fluids; *BID*, twice daily; *UOP*, urine output; *d/c*, discontinue.

Table II
Pre-ERAS versus post-ERAS postoperative care

	Pre-ERAS	Post-ERAS
Pain control	Epidural Variable non-narcotic regimens Gabapentin not used	TAP-block + PCA Scheduled Tylenol + gabapentin Earlier use of PO oxycodone
Diet	NPO POD#0 Variable diet advancement Regular diet once having bowel function	Clears POD#0 Earlier diet advancement
Fluids	Variable intraop fluid and postop regimens	Goal-directed fluids Limited fluids postop
Foley catheters	Routinely placed Foley continued while epidural in place	Discontinue Foley on POD2
Nasogastric tubes	Placed if bowel resection, enterotomy, prolonged lysis of adhesions	Not utilized in immediate postoperative period

bridged repairs, or complex autologous tissue reconstruction with free myocutaneous flaps were excluded. In addition, patients who were unable to be extubated immediately postoperatively were excluded.

A multimodal approach to pain control was used, starting with intraoperative transversus abdominis plane (TAP) blocks. TAP blocks were performed by the surgeon with 20 mL of bupivacaine liposomal suspension diluted in 80 mL of 0.9% NaCl and injecting 50 mL of the solution per side in 5 different locations into the cut edge of the transversus abdominus during the operation. Postoperatively, patients were given intravenous, patient-controlled analgesia (PCA) with hydromorphone at a maximum of 0.2 mg every 6 min. Fentanyl was used as an alternative for PCA if there was an allergy or other contraindication to hydromorphone. The PCA was weaned as oral analgesics were introduced and was discontinued on postoperative day (POD) 3 if patients were tolerating a regular diet. Scheduled oral acetaminophen (650 mg every 6 hours) and gabapentin (300 mg 3 times daily) were started on POD1. Oxycodone 5 mg every 4 h as needed was started on POD2 if patients were tolerating oral intake. Intravenous ketorolac was used at the discretion of the attending surgeon.

Bowel regimen consisting of milk of magnesia (30 mL twice daily) and docusate (100 mg twice daily) was started on POD1. Clear liquid diet was started on POD0 and advanced as tolerated to a regular diet on POD2-3. Intravenous fluids were limited, with goal-directed fluid intraoperatively and judicious use of IV fluids postoperatively. Initially, patients were started on 75 mL/h of IV fluids and decreasing the rate, as diet was advanced with a goal to discontinue IV fluids on POD3.

Routine laboratory workup, including basic metabolic panel and complete blood count, were obtained for 2 occurrences postoperatively and thereafter only as indicated clinically. Nasogastric tubes were not used routinely in the immediate postoperative period. Foley catheters were placed after induction of general anesthesia and removed on POD2 barring any ongoing need for the closer monitoring of urine output. Subfascial drains were routinely placed intraoperatively and were removed when the drain output was less than 30 mL/24 h or at the discretion of the attending surgeon. Early ambulation and mobilization were encouraged, and physical therapy was consulted as needed to aid with ambulation.

Patients were deemed stable for discharge once they were tolerating a regular diet, voiding spontaneously, having bowel movements, and pain was controlled with oral medications. The goal was for discharge on POD4 or POD5 if the aforementioned criteria were met.

A standard order set was made within the electronic medical record. The attending surgeons, resident-physicians, mid-level providers, and nurses were educated on the new protocol.

Based on an historic LOS of 6 days with a standard deviation of 2.5 days for our patient population, we performed a sample size calculation with an α of 0.05, power of 0.8, and determined that 100 patients were needed in each arm to detect a difference in LOS of 1 day.

After obtaining approval by our Institutional Review Board, the ERAS protocol was implemented, and data were collected prospectively. The study cohort (ERAS group) was compared with the data from a historic group of patients who underwent AWR before implementation of the ERAS protocol (control group), which were obtained via retrospective chart review. Basic demographics and patient characteristics, such as age, sex, body mass index, smoking status, comorbidities, and American Society of Anesthesiologists

Table III
Patient demographics

	Pre-ERAS	Post-ERAS	*P* value
Age (y)	58 ± 14	57 ± 14	.59
Sex			
Male	36	53	.02
Female	64	47	
BMI (kg/m^2)	32.3 ± 5.8	31.0 ± 5.4	.10
ASA			
1	1	0	.48
2	18	14	
3	78	79	
4	3	7	
HerQles baseline	53.8 ± 15.2	50.8 ± 15.5	.29
Raw pain score baseline	43.8 ± 11.8	45.4 ± 11.8	.48
Current nicotine use	9%	4%	.25
Chronic obstructive pulmonary disease	7%	9%	.80
Diabetes mellitus	26%	18%	.23
Recurrent hernia	56%	53%	.78

BMI, body mass index; *ASA*, American Society of Anesthesiologists Class.

Table IV
Operative variables

	Pre-ERAS	Post-ERAS	*P* value
Procedure			
TAR	99	91	.24
Flank hernia	1	6	
Onlay	0	2	
Retrorectus	0	1	
CDC wound class			
1	83	91	.19
2	10	5	
3	7	2	
4	0	1	
Mesh material			
Synthetic	96	99	.37
Biologic	4	1	
Hernia width (cm)	15.6 ± 5.5	15.5 ± 6.2	.94
Operative time (h)	3.7 ± 0.9	3.6 + 1.0	.35

CDC, Centers for Disease Control and Prevention; *TAR*, transversus abdominis release.

classification were obtained. In addition, we recorded operative variables, such as type of hernia repair, operative time, size of the hernia defect, and type and size of the mesh used. Postoperatively, time to regular diet, time to discontinuation of epidural or PCA, and inpatient and 30-day complications were tracked. HerQles is a 12-question, disease-specific, quality-of-life measurement survey specific to ventral hernia, in which greater scores are associated with a better quality of life and a more functional abdominal wall.[12] The HerQles score and raw pain scores were obtained preoperatively and 30 days postoperatively. Groups were compared, with primary outcome being LOS. Data were described using mean and standard deviation for continuous variables and counts and percentages for categorical variables. Groups were compared on demographics and clinical characteristics using χ^2, Fisher exact, 2 sample *t* tests, and Mann-Whitney *U* test as appropriate. All analyses were performed on a complete-case basis. All tests were 2-tailed and performed at a significance level of 0.05. R 3.3.1 (Vienna, Austria) was used for all analyses.

Results

The pre- and post-ERAS groups were similar, with the exception of the pre-ERAS group containing more females. Age, body mass index, American Society of Anesthesiologists class, and baseline, hernia-specific quality of life score were similar between groups (Table III). Groups were also comparable with regard to procedure performed, wound class as per the classification by the Centers for Disease Control, type of mesh used, hernia size, and operative time (Table IV). Average hernia width was similar between the pre-ERAS and post-ERAS groups (15.6 ± 5.5 vs 15.5 ± 6.2 cm, $P = .37$). There was a large number of recurrent hernias in each group (56% pre-ERAS vs 53% post-ERAS, $P = .78$).

Table V
Postoperative variables

	Pre-ERAS	Post-ERAS	*P* value
LOS (d)*	5 (4–7)	5 (4–7)	.78
Time to regular diet (d)*	3 (2.8–4)	3 (2–4)	.14
Time to discontinuation of patient-controlled analgesia (d)*	3 (2–4)	3 (2–4)	.01
Time to discontinuation of Foley catheter (d)	3 (2–4)	2 (2–2)	<.01
Complication rate	30	36	.45
Respiratory	12	14	
Ileus	8	11	
AKI	1	3	
UTI	5	2	
Acute blood loss anemia	1	3	
A fib with RVR	2	3	
SSI/SSO	3	3	
Hypotension	4	0	
Inpatient complication			
Yes	30	36	.45
No	70	64	
30-day readmission			
Yes	9	12	.64
No	91	88	
HerQles 30-day post-operative	45.2 ± 11.3	49.1 ± 8.3	.10
Raw pain score 30-day postoperative	57.8 ± 17.3	52.8 ± 15.1	.20

AKI, acute kidney injury; *UTI*, urinary tract infection; *RVR*, rapid ventricular response; *SSI*, surgical site infection; *SSO*, surgical site occurrence.
* Median (interquartile ranges).

There was no change in LOS with the ERAS protocol (median 5 vs 5 days, $P = .78$). Postoperative variables are summarized in Table V. There was no difference in time to regular diet (median 3 vs 3 days, $P = .14$). There was a trend toward a decreased duration of use of epidurals or PCA owing to outliers (median 3 vs 3 days, $P = .01$). The time Foley catheters were used postoperatively was decreased (median 3 vs 2 days, $P < .01$). There was no increase in complications or 30-day readmissions in the post-ERAS group (30% vs 36%; $P = .45$ and 9% vs 12%; $P = .64$, respectively).

To identify which factors were associated with short and long hospital stays, a subgroup analysis was performed comparing patients who stayed ≤4 days vs ≥6 days (± 1 day from the median). In subgroup analysis, numerous clinical factors were associated with a LOS <4 days or a LOS >6 days (Table VI). Smaller defects (hernia width 9.5 ± 7.2 cm, $P = .009$), shorter operative times (2.5 ± 0.8 hours, $P = .001$), and greater preoperative quality of life scores (HerQles score 59.5 ± 11.7, $P = .008$) were associated with a LOS of <4 days. Conversely, larger defects (hernia width 17.3 ± 6.5 cm, $P = .009$), longer operative times (3.77 ± 1.0 hours, $P = .001$), and lesser preoperative quality of life scores (HerQles score 44.4 ± 15.6, $P = .008$) were associated with a LOS >6 days.

Discussion

Utilizing a multimodal approach to postoperative recovery, we developed an ERAS pathway for patients undergoing AWR. There was no change in LOS or time to regular diet after introduction of the ERAS pathway, although there was a trend toward less PCA use. The decrease in PCA use, however, was not clinically significant because the median days was unchanged. Duration of the foley catheter was decreased by 1 day. Overall, however, there was also no change in complication rates or 30-day readmissions. Less

Table VI
Subgroup analysis of LOS

	LOS <4 days (n = 10)	LOS >6 days (n = 26)	*P* value
Age (y)	56.1 ± 12.3	62.5 ± 12.2	.18
Sex			
Male	5 (50%)	12 (46%)	1.0
Female	5 (50%)	14 (54%)	
BMI (kg/m^2)	30.8 ± 4.5	31.8 ± 5.4	.58
ASA			
1	0 (0%)	0 (0%)	.50
2	0 (0%)	1 (4%)	
3	10 (100%)	21 (81%)	
4	0 (0%)	4 (15%)	
Procedure			
TAR	7 (70%)	24 (92%)	.036
Flank hernia	0 (0%)	2 (8%)	
Onlay	2 (20%)	0 (0%)	
Retrorectus	1 (10%)	0 (0%)	
Hernia width (cm)	9.5 ± 7.2	17.3 ± 6.5	.009
Operative time (hours)	2.5 ± 0.8	3.77 ± 1.0	.001
HerQles score			
Baseline	59.5 ± 11.7	44.4 ± 15.6	.008
30-day postoperative	63.2 ± 18.8	51.5 ± 13.2	.19

BMI, body mass index; *ASA*, American Society of Anesthesiologists Class.

complex patients with smaller hernias and a better quality of life who required shorter operations were more likely to have a shorter hospital stay. But overall, it seems that our protocol of enhanced recovery had little impact in more complex hernia patients that dominate our practice.

Our pathway was developed based on existing practice patterns and available literature regarding the various components of ERAS protocols. Before the creation of the ERAS protocol, our group used epidurals routinely for postoperative analgesia in patients undergoing posterior component separation. Prabhu et al found that epidurals were associated with a greater rate of complications and a longer LOS.[13] Therefore, we chose to discontinue epidurals in our practice and instead use TAP blocks which have shown efficacy for postoperative analgesia in abdominal surgery including ventral hernia repair.[14,15] Intraoperative TAP blocks performed under direct visualization by the surgeon have been shown to be superior to ultrasonographic-guided TAP blocks in patients undergoing posterior component separation.[16]

In an attempt to decrease overall narcotic use and enhance recovery, a multimodal pain regimen was used, which has been shown to decrease opioid requirements in patients undergoing ventral hernia repair.[17] In addition to regional anesthesia, scheduled acetaminophen and gabapentin were started on POD1, which have been shown to decrease pain scores and narcotic use.[18] Nonsteroidal anti-inflammatory agents (IV ketorolac) were used at the discretion of the attending surgeon in patients with normal renal function, normal platelets, and low risk of bleeding. Oral narcotic pain medication was available for rescue, with a goal of discontinuing IV narcotics as soon as possible.

Perioperative use of alvimopan has been shown to decrease time to return of bowel function and decrease the rate of postoperative ileus in patients undergoing bowel resection.[19,20] Because the majority of our patients not require bowel resection, alvimopan was not included in our ERAS protocol. Instead, we initiated early enteral feeding and the avoidance of nasogastric tubes, which in the colorectal literature leads to earlier return of bowel function and shorter LOS.[21]

The overall LOS for both our study cohorts was 5 days, and we did not demonstrate any decrease in LOS with an ERAS protocol, which is in opposition to several studies on ERAS and ventral hernia repair. In comparison, Fayezizadeh et al published preliminary results for an ERAS pathway in 42 patients undergoing AWR, which showed a mean decrease in LOS of 1.4 days[9]; however, in their study, there were no details regarding size of hernia or operative details. Because we demonstrated in our study that larger defects have longer an overall LOS and are less likely to benefit from ERAS, we cannot reliably compare these 2 studies and draw meaningful conclusions. Jensen et al published an observational study, evaluating the effect of ERAS pathway on 16 patients undergoing ventral hernia repair using a retrorectus repair for defects >10 cm. They also demonstrated a decrease in LOS from 5.5 to 3.0 days, with no difference in complications or readmissions[10]; however, given the small sample size, this study may have been underpowered to detect to a true difference. In contrast to our patient population in which the majority of patients required a posterior component separation for repair, only 3 of their patients required an anterior component separation and no posterior component separations were performed. Given that our patient population had larger defects and required more extensive operations for repair, these patient populations are not also comparable.

Majumder et al studied an ERAS protocol for patients undergoing ventral hernia repair with posterior component separation and transversus abdominis release. In this prospective cohort study, 100 patients with an average defect size of 13.2 cm were compared to a historic control group; this study suggested a decrease in LOS from 6.1 to 4.0 days. In addition, they found a lesser readmission rate in the ERAS group.[8] In that study, however, patients undergoing bowel resection, biologic mesh placement owing to contamination, postoperative intubation, and intensive care unit admission were excluded from analysis.[8] In contrast, our study included all Centers for Disease Control and Prevention wound classes, patients undergoing concomitant bowel resection, and biologic mesh placement but not those requiring postoperative ventilation. In addition, we evaluated our data as an intention to treat analysis; therefore, patients who experienced complications that extended their LOS were still included in the ERAS group. This design may be one reason we did not see a difference in LOS between our control group and study group. In addition, Majumder et al used alvimopan in their protocol, which was not utilized in our pathway.

In an analysis looking at predictors of LOS, we found that patients with a LOS <4 days had smaller defect sizes (9.5 ± 7.2 cm), shorter operative times (2.5 ± 0.8 hours), and greater baseline quality of life score (HerQles score 59.5 ± 11.7). In comparison, a defect size of 17.3 ± 6.5 cm and an operative time of 3.8 ± 1.0 hours were associated with a LOS >6 days. Previous studies have demonstrated that with patients more complex hernias have lesser baseline HerQles scores.[21] Taking HerQles score, hernia size, and operative course into consideration, we may be able to predict which patients would be more appropriate for an ERAS pathway and be able to be discharged earlier. This approach may also identify which patients are at risk for a prolonged LOS and therefore would benefit from more aggressive, preoperative optimization to enhance postoperative recovery.

There are several limitations to this study. Our study was designed as a cohort study and relied on a historic control group for comparison and patients were not randomized. Although consecutive patients undergoing AWR were used in each group, there was nearly a year gap between the control group and the cohort group. Changes in practice patterns and hospital policies may not have been the same between the 2 groups. Hospital policies and discharge practices may have already been more aggressive. This possibility is supported by the fact that our actual LOS in the pre-ERAS group was 5 days, which was shorter than the historic database LOS of 6 days that was originally used in the power calculation. Furthermore, a large proportion of our patient population is from

out of state. Long travel distances may have influenced the pattern of discharge practice. Patients were analyzed based on actual LOS rather than time to discharge readiness, and this fact may have affected our results.

In addition, we based our power calculation on a historic LOS of 6 days. In our study, however, we found a LOS of 5 days in the control group. Therefore, the study may not have been powered sufficiently to see a change in LOS. Although secondary outcomes, such as complications and time to regular diet, were analyzed, the study was not powered to find differences in those variables. Therefore, we are unable to draw conclusions about differences in complications, readmission rates, or other clinical outcomes.

Future areas of study include modifying the existing pathway and continuously improving on it in order to achieve optimal recovery for our patients. The possibilities could include a more aggressive pathway for patients with smaller hernia defects, shorter operative times, and greater quality of life scores, because these factors were associated with a shorter LOS in our study. In addition, we plan to study additional measures, such as use of alvimopan, and incorporate its use into the ERAS pathway if the results are positive.

Although we did not demonstrate a decrease in LOS, we were able to identify factors that were associated with a shorter LOS. There are several factors that may explain our unchanged LOS, including the fact that we included all cases in the analysis, regardless of adhesiolysis time, concomitant bowel resection, or enterotomy. In addition, as a complex tertiary care center, our practice includes many complex hernias with larger defects. Based on our subgroup analysis, a longer LOS is associated with hernias of this size. Finally, we used an intention-to-treat analysis, and, therefore patients with postoperative complications who deviated from the ERAS pathway were still included. Our ERAS pathway allowed for a standardized, postoperative protocol for our patients that represents a multimodal approach to patient care.

Funding/Support

No outside funding was received for support of this research

Conflict of interest/Disclosure

The authors have no conflicts of interest to disclose.

References

1. Kleppe KL, Greenberg JA. Enhanced recovery after surgery protocols: Rationale and components. *Surg Clin North Am*. 2018;98:499–509.
2. Spanjersberg WR, Reurings J, Keus F, van Laarhoven CJ. Fast track surgery versus conventional recovery strategies for colorectal surgery. *Cochrane Database Syst Rev*. 2011:CD007635.
3. Fearon KCH, Ljungqvist O, Von Meyenfeldt M, et al. Enhanced recovery after surgery: A consensus review of clinical care for patients undergoing colonic resection. *Clin Nutr Edinb Scotl*. 2005;24:466–477.
4. Walter CJ, Watson JT, Pullan RD, Kenefick NJ, Mitchell SJ, Defriend DJ. Enhanced recovery in major colorectal surgery: Safety and efficacy in an unselected surgical population at a UK district general hospital. *Surg J R Coll Surg Edinb Irel*. 2011;9:259–264.
5. Wind J, Polle SW, Fung Kon Jin PHP, et al. Systematic review of enhanced recovery programmes in colonic surgery. *Br J Surg*. 2006;93:800–809.
6. Varadhan KK, Neal KR, Dejong CHC, Fearon KCH, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: A meta-analysis of randomized controlled trials. *Clin Nutr Edinb Scotl*. 2010;29:434–440.
7. Nicholson A, Lowe MC, Parker J, Lewis SR, Alderson P, Smith AF. Systematic review and meta-analysis of enhanced recovery programmes in surgical patients. *Br J Surg*. 2014;101:172–188.
8. Majumder A, Fayezizadeh M, Neupane R, Elliott HL, Novitsky YW. Benefits of multimodal enhanced recovery pathway in patients undergoing open ventral hernia repair. *J Am Coll Surg*. 2016;222:1106–1115.
9. Fayezizadeh M, Petro CC, Rosen MJ, Novitsky YW. Enhanced recovery after surgery pathway for abdominal wall reconstruction: Pilot study and preliminary outcomes. *Plast Reconstr Surg*. 2014;134(4 Suppl 2):151S–159S.
10. Jensen KK, Brondum TL, Harling H, Kehlet H, Jorgensen LN. Enhanced recovery after giant ventral hernia repair. *Hernia J Hernias Abdom Wall Surg*. 2016;20:249–256.
11. Macedo FIB, Mittal VK. Does enhanced recovery pathways affect outcomes in open ventral hernia repair? *Hernia J Hernias Abdom Wall Surg*. 2017;21:817–818.
12. Krpata DM, Schmotzer BJ, Flocke S, et al. Design and initial implementation of HerQLes: A hernia-related quality-of-life survey to assess abdominal wall function. *J Am Coll Surg*. 2012;215:635–642.
13. Prabhu AS, Krpata DM, Perez A, et al. Is it time to reconsider postoperative epidural analgesia in patients undergoing elective ventral hernia repair?: An AHSQC analysis. *Ann Surg*. 2018;267:971–976.
14. Chesov I, Belîi A. Postoperative analgesic efficiency of transversus abdominis plane block after ventral hernia repair: A prospective, randomized, controlled clinical trial. *Romanian J Anaesth Intensive Care*. 2017;24:125–132.
15. Petersen PL, Mathiesen O, Torup H, Dahl JB. The transversus abdominis plane block: A valuable option for postoperative analgesia? A topical review. *Acta Anaesthesiol Scand*. 2010;54:529–535.
16. Doble JA, Winder JS, Witte SR, Pauli EM. Direct visualization transversus abdominis plane blocks offer superior pain control compared to ultrasound guided blocks following open posterior component separation hernia repairs. *Hernia*. 2018;22:627–635.
17. Warren JA, Stoddard C, Hunter AL, et al. Effect of multimodal analgesia on opioid use after open ventral hernia repair. *J Gastrointest Surg*. 2017;21:1692–1699.
18. Sen H, Sizlan A, Yanarateş O, et al. The effects of gabapentin on acute and chronic pain after inguinal herniorrhaphy. *Eur J Anaesthesiol*. 2009;26:772–776.
19. Tan EK, Cornish J, Darzi AW, Tekkis PP. Meta-analysis: Alvimopan vs. placebo in the treatment of post-operative ileus. *Aliment Pharmacol Ther*. 2007;25:47–57.
20. Delaney CP, Craver C, Gibbons MM, et al. Evaluation of clinical outcomes with alvimopan in clinical practice: A national matched-cohort study in patients undergoing bowel resection. *Ann Surg*. 2012;255:731–738.
21. Bauer VP. The evidence against prophylactic nasogastric intubation and oral restriction. *Clin Colon Rectal Surg*. 2013;26:182–185.