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Thoracic Epidural Analgesia: Does It Enhance Recovery?

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Abstract

BACKGROUND: Thoracic epidural analgesia has been shown to be an effective method of pain control. The utility of epidural analgesia as part of an enhanced recovery after surgery protocol is debatable.

OBJECTIVE: This study aimed to determine if the use of thoracic epidural analgesia in an enhanced recovery after surgery protocol decreases hospital length of stay or inpatient opioid consumption after elective colorectal resection.

DESIGN: Single institution retrospective cohort study.

SETTINGS: The study was performed at a high volume, tertiary care center in the Midwest. An institutional database was used to identify patients.

PATIENTS: All patients undergoing elective transabdominal colon or rectal resection by board certified colon and rectal surgeons from 2013 to 2017.

MAIN OUTCOME MEASURES: The main outcome was length of stay. The secondary outcome was oral morphine equivalents consumed during the first 48 hours.

RESULTS: There were 1006 patients (n=815 epidural, 191 no epidural) included. All patients received multimodal analgesia with opioid sparing agents. Univariate analysis demonstrated no difference in length of stay between those who received thoracic epidural analgesia and those who did not (median 4 vs. 5 days, p=0.16), which was substantiated by multivariable linear regression. Subgroup analysis showed the addition of epidural analgesia resulted in no difference in length of stay regardless of open (n=362, p=0.66) or minimally invasive (n=644, p=0.46) approach. Opioid

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Author contributions

All authors contributed significantly to the study concept and design. DR and RW performed data acquisition. JV performed statistical analysis of the data. All authors contributed to interpretation of the data. All authors contributed to drafting and revising the work, approve the final version, and agree to be accountable for all aspects of the work.

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consumption data was available since 2015 (n=497 patients). Univariate analysis demonstrated no difference in morphine equivalents consumed in the first 48 hours between patients who received epidural analgesia and those who did not (median 135 vs. 110 oral morphine equivalents, p=0.35). This was also confirmed by multivariable linear regression.

LIMITATIONS: Retrospective observational design.

CONCLUSION: The use of thoracic epidural analgesia within an enhanced recovery after surgery protocol was not found to be associated with a reduction in length of stay or morphine equivalents consumed within the first 48 hours. We cannot recommend routine use of thoracic epidural analgesia within enhanced recovery after surgery protocols. See **Video Abstract** at <http://links.lww.com/DCR/Axxx>.

Keywords

Analgesia; Colorectal surgery; Enhanced recovery; Epidural; Pain management

Introduction

Enhanced recovery after surgery (ERAS) protocols are a mainstay in colorectal surgery. A critical component of ERAS protocols is multimodal analgesia.^{1,2} Despite its importance, the specifics of multimodal analgesia are not standardized, and can vary widely between institutions.^{3,4} The primary goal of multimodal analgesia is to avoid the delivery of systemic opioids. Although effective for pain control, systemic opioids slow colonic motility and increase postoperative ileus.⁵ A common regional anesthesia technique employed for postoperative pain control in abdominal surgery is thoracic epidural analgesia (TEA).⁶⁻⁸ TEA may be used within ERAS pathways and delivers local anesthetic with or without opioids.^{6,7,9}

In a Cochrane review of 128 trials with 8754 patients, the use of TEA with abdominal surgery has been associated with quicker return of bowel function, improved pain control, and decreased length of hospital stay.⁸ However, these benefits are not as clear in colorectal surgery. In initial studies comparing TEA to systemic opioids in colorectal surgery, epidural analgesia was found to provide better pain control, decreased incidence of ileus, and quicker return of bowel function.¹⁰⁻¹⁴ Yet, recent studies have been unable to confirm these benefits, and in fact have shown a greater risk of hypotension and urinary retention with TEA.¹⁵⁻¹⁸ A major difference between these two bodies of work is the presence of ERAS multimodal pain protocols in more recent studies.

Given the lack of consistent data, we sought to examine the effect of TEA on immediate postoperative pain control and overall inpatient recovery within our ERAS protocol. After noting recent publications doubting the utility of TEA in an ERAS protocol, we questioned whether our utilization of TEA was beneficial. Our aim was to examine our experience in an effort to discern if TEA had resulted in an improvement in length of stay or systemic opioid consumption when applied as a standard adjunct to all patients receiving colorectal surgery.

Materials and Methods

This is a retrospective review of all patients undergoing elective transabdominal colon or rectal resection by specialty-trained colon and rectal surgeons at a tertiary care center from 2013 to 2017. This study was approved by our Institutional Review Board. Utilizing our own institutional participation in the American College of Surgeons National Surgical Quality Improvement Program® (ACS NSQIP), all patients in this cohort were identified at our hospital. Per institutional protocol, all patients were considered for TEA. In addition, standard ERAS protocol during this time period utilized a multimodal pain regimen including patient controlled analgesia (PCA) with intravenous opioids and scheduled nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentin, and oral acetaminophen. Other ERAS elements included preoperative immunonutrition, mechanical bowel prep with oral antibiotics, intravenous antibiotic prophylaxis, thromboprophylaxis, and administration of alvimopan. Intraoperatively and postoperatively, a fluid restrictive/goal-directed strategy was utilized. Postoperative early removal of Foley catheter (postoperative day POD #3 for low pelvic dissections and POD #1 for all others), POD #0 mobilization, and early initiation of oral diet were employed.

Patient variables abstracted from the ACS NSQIP database included demographics (age, sex, body mass index (BMI)), comorbid conditions, and overall length of stay (LOS, time from date of elective surgery to date of discharge). To measure opioid consumption, we queried our institutional pharmacy database used to track administration of all medications administered as an inpatient. Pharmacy data was available since 2015. Standard TEA concentration was 0.1% bupivacaine without opioid. Oral morphine equivalents were calculated by converting all opioid medications consumed utilizing validated resources.^{19,20} Analysis was performed comparing those who received TEA with bupivacaine and those who did not. All patients were considered for TEA; patients were ruled out if deemed inappropriate for TEA. Data regarding exactly why individual patients were ruled out for TEA was not collected at the time of surgery and therefore unavailable in this retrospective review. Anecdotal questioning of the surgeons operating during this time period showed reasons for not utilizing TEA included patient preference, anatomically prohibitive/failed placement of epidural catheter, and preoperative anticoagulation/antiplatelet status. A pain management team rounded on the patients postoperatively and weaned the patient off of TEA as their pain was controlled with other medications.

Board-certified anesthesiologists performed all epidural catheter insertions. Epidural catheter location was, in part, determined by the location of the incisions. The desired sensory nerve block from TEA should cover the length of the incision (or extraction incision in the case of minimally invasive surgery), but there are other considerations. For example, a more cephalad block may be associated with greater episodes of hypotension, and a more caudal location increases rate of urinary retention.^{21–25} For left-sided and rectal resections with lower abdominal incisions, T10 was the most common level used. For right-sided resections with more cephalad incisions, placement at T8 or T9 was often utilized.

Primary outcome was the difference in length of stay (LOS) between those receiving TEA and those not; secondary outcome was oral morphine equivalents consumed during the first

48 hours. Univariate regression was performed to determine the differences in LOS and opioid consumption for patients receiving TEA and those who did not. Since we were interested in immediate postoperative pain control and all epidural catheters were in place for at least two days, we only considered opioid consumption within the first two postoperative days. Multivariable linear regressions were then performed utilizing the demographics outlined in Table 1 to determine if the use of TEA affected LOS or morphine equivalent consumption within the first 48 hours. Stratified analyses of both primary and secondary outcomes by operative approach were also performed. Both LOS and opioid consumption were considered to be continuous variables and modeled using linear regression techniques.

Results

There were 1006 patients (520 females, 486 males) who underwent colorectal resection during the study period. Demographic characteristics between those receiving TEA or not were similar at baseline (see Table 1), although there were some differences. Patients receiving TEA included a greater percentage of patients with American Society of Anesthesiologists Class (ASA) 1 or 2 and a greater percentage of patients received a minimally invasive approach compared to an open approach. Median age was 59 years old (interquartile range IQR 52–69) and median BMI 27.6 (IQR 25–32). Diabetes mellitus was present in 13.2%, hypertension in 45.8%, and 23.3% of patients were smokers. Metastatic disease was present in 14.2% of patients, 14.1% had baseline dyspnea, and 17.6% of patients were on steroids preoperatively. ASA 1 or 2 applied to 52.6% of patients, and thus 3 or 4 in 47.4% of patients. Right-sided resections were performed in 39% of patients and left-sided or rectal resections were performed in 61% of patients. TEA was given in 815 patients (81%) of the overall cohort.

Univariate analysis demonstrated no statistically significant difference in LOS between those who received TEA and those who did not (median 4 vs. 5 days, mean 5.7 vs. 6.1 days, $p=0.16$, IQR 3–7 days for both groups). Multivariable linear regression further substantiated this ($p=0.40$, see Table 2). Multivariable linear regression identified these factors increasing LOS: open approach ($p<0.001$), presence of metastatic disease ($p=0.02$), preoperative dyspnea ($p=0.04$), and ASA 3 or 4 ($p=0.046$). Minimally invasive approach was associated with decreased LOS by an average of 2.2 days compared to open surgery ($p<0.001$). Stratified analysis of LOS by operative approach was then performed. Again, the addition of TEA resulted in no statistically significant difference in LOS regardless of open (median=6 vs. 6 days, $p=0.82$, IQR 5–7 for both groups, $n=362$) or minimally invasive (median=4 vs. 4 days, $p=0.94$, IQR 3–5 for both groups, $n=644$) approach in both univariate and multivariable regression analyses (see Tables 3 and 4).

Inpatient opioid consumption data was only available since 2015 ($n=497$ patients, 399 TEA, 98 no TEA). Both oral and parenterally administered opioids were included in analysis. Univariate analysis demonstrated no statistically significant difference in oral morphine equivalents consumed in the first 48 hours (MME48) between patients who received TEA and those who did not (median 135, IQR 118–150 vs. 110, IQR 92–130 oral morphine equivalents, $p=0.35$), which was substantiated by multivariable linear regression (see Table

5). Multivariable linear regression identified preoperative smoking ($p=0.005$) and ASA 3 or 4 ($p=0.001$) as factors resulting in an increase in MME48. Minimally invasive approach ($p<0.001$) and increasing age ($p<0.001$) were factors resulting in a decrease in MME48. Stratified analysis of opioid consumption by operative approach was then performed. By univariate analysis, TEA did not reduce the consumption of morphine equivalents in the first 48 hours for minimally invasive (median 120, IQR 102–136 vs. 95, IQR 80–114 MME48, $p=0.197$, $n=303$) or open cases (median 178.8, IQR 160–194 vs. 174.5, IQR 158–190 MME48, $p=0.650$, $n=194$). This was confirmed by multivariable linear regression. Multivariable linear regression of the minimally invasive group identified ASA 3 or 4 ($p=0.022$) as a factor increasing MME48 and age as a variable decreasing MME48 ($p<0.001$). Similarly, in the open group, multivariable linear regression identified ASA 3 or 4 ($p=0.037$) and smoking ($p=0.030$) as factors increasing MME48 and age ($p<0.001$) as a variable decreasing MME48.

Discussion

Our results show that in the context of multimodal analgesia and an ERAS pathway, the use of TEA had no impact on length of stay or in-hospital opioid consumption following colorectal surgery. As seen in Table 1, the two groups were similar with regards to demographics. Multivariable linear regression did not show a difference in LOS with the addition of TEA to a multimodal analgesia regimen. As seen in Table 2, the use of a minimally invasive approach significantly decreases the LOS in our dataset, with a 95% confidence interval of -1.6 to -2.7 days. This is in line with other studies that have shown a decrease in LOS with minimally invasive colorectal surgery,^{26,27} and further validates our dataset. Although recent studies have contested the utility of TEA in elective laparoscopic colectomy, TEA has been previously noted to have its greatest efficacy in open abdominal surgery.⁸ Thus, a subgroup analysis was performed to evaluate whether there was any effect on LOS within either the minimally invasive or open groups. As seen in Tables 3 and 4, the addition of TEA did not change LOS in either of these groups. Other variables in our multivariable linear regression models found to contribute to increasing LOS (metastases, dyspnea, ASA 3 or 4, and heart failure) are comorbidities that would not unexpectedly increase LOS (see Tables 2–4).

Additionally, pharmacy data was examined to see if employing TEA had any effect on opioid consumption. We found no benefit of TEA to a multimodal analgesia regimen. Not surprisingly, the use of a minimally invasive approach significantly decreases the MME48 in our data set. This is in line with other studies that show lower pain scores and need for pain medication with minimally invasive colorectal surgery,^{26,27} and further validates our dataset. Again, as TEA has been shown to have its greatest efficacy in open abdominal surgery,⁸ a subgroup analysis was performed to determine if there was any difference in opioid consumption rates when TEA was added to a minimally invasive or open approach. This showed that there was no alteration in MME48 when TEA was used with either a minimally invasive or open approach. Other variables found to contribute to increasing MME48 in our multivariable linear regression included smoking and ASA 3 or 4. It is unclear why this occurred. Lastly, increased age correlated with a decrease in MME48. This is in line with other work that has shown the same correlation.²⁸

Studies examining whether the benefits of TEA apply specifically to the field of colorectal surgery have yielded mixed results. A 2001 randomized trial by Carli et al. compared 21 patients undergoing elective colorectal surgery who received postoperative epidural analgesia with 21 patients who were administered morphine PCA. They found superior pain control and quicker time to first flatus and bowel movement in the TEA group. However, discharge to home was not faster (7.3 days in PCA group vs. 8.5 days in the TEA group).¹¹ In 2009, Zingg et al. randomized 75 patients undergoing elective colorectal surgery to TEA and non-TEA groups. The TEA group had less analgesic consumption, better pain relief, and faster recovery of gastrointestinal function. Of note, the only scheduled opioid-sparing analgesic used in their protocol was acetaminophen.¹⁴ A 2007 meta-analysis by Marret et al. examining all studies comparing TEA and parenteral opioid administration in colorectal surgery et al. echoed these findings. Analyzing sixteen trials between 1987 and 2005, this group discovered that TEA significantly reduced pain scores and duration of ileus. On the other hand, they found an increase in pruritis, episodes of hypotension, and urinary retention. There was no effect of TEA on LOS.¹⁰

The benefits of TEA have more recently been challenged in colorectal surgery. As ERAS protocols have expanded, so has the utilization of multimodal analgesia regimens with opioid-sparing agents, including gabapentinoids, NSAIDs, acetaminophen, lidocaine, ketamine, and alpha-2 agonists.³ In 2015, Hubner et al. performed a randomized control trial of 128 patients assigned to either TEA or PCA in elective laparoscopic colorectal surgery within an ERAS pathway utilizing multimodal analgesia. They found no difference in postoperative pain scores, and the TEA group required more vasopressor agent use as well as a nonsignificant trend towards greater LOS (median 5 vs. 4 days, $p=0.082$).¹⁷ Similarly, Hanna randomized 87 patients undergoing elective laparoscopic colorectal surgery to TEA vs. IV opioid analgesia within an ERAS pathway utilizing non-opioid multimodal analgesia. The TEA group had more episodes of hypotension, longer urinary catheter duration, and greater use of narcotics. There was no difference in LOS.¹⁵

Limitations of this study include incomplete data regarding preoperative narcotic use and decision-making leading to TEA omission. Since all patients were considered for TEA placement per protocol, epidurals were likely not omitted at random among this population. In addition, the epidural rate used for TEA could not be assessed, only if the patient received TEA or not. Also, outside of the scheduled opioid-sparing medications such as gabapentin, NSAIDs, and acetaminophen used in the institutional protocol, use of additional adjuncts such as intravenous lidocaine infusion and transversus abdominis plane (TAP) blocks was not standardized and used intermittently. Due to its retrospective nature, data points not previously recorded such as pain scores and return of gastrointestinal function could not be measured. In addition, type of minimally invasive surgery was not standardized. The minimally invasive group included hand assist laparoscopic surgery, total laparoscopic surgery, and robotic surgery.

This work agrees with recent studies that have questioned the benefit of TEA in colorectal surgery. Among our large study of clinical outcomes from a tertiary specialty practice, we failed to show a clinical benefit of TEA in elective colorectal surgery. Historically, some studies did show a clinical benefit. It is likely, however, that more recent studies have failed

to show this benefit as widespread adoption of ERAS pathways with multimodal opioid-sparing analgesia has emerged. TEA is not without risk, as epidurals in colorectal surgery have been associated with increased fluid boluses for hypotension and increased urinary retention.^{10,15} Additional risks include bleeding (1:10,000) and infection (1:10,000), which occur infrequently.²⁹ TEA also adds an additional cost, as utilization requires additional resources as typically a pain management team places the catheter and manages the epidural regimen postoperatively. It should be emphasized that this study adds to the literature with a novel finding of no clinical benefit of TEA in open elective colon and rectal surgery. It is our belief that this is due to adherence to an ERAS protocol that overcomes any benefit of TEA shown by previous studies in open surgery.

This study did not find a reduction of LOS or morphine equivalents consumed within the first 48 hours with the addition of TEA to an ERAS protocol that used a multimodal analgesia regimen. In light of the costs and potential side effects of this adjunct without demonstrable benefit in this large series, we cannot recommend routine use of TEA within ERAS protocols. Further prospective studies are warranted to confirm our findings.

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Table 1:

Demographics

Demographic	Epidural= No (191)	Epidural=Yes (815)	p-value
Age			0.604
Median	59	59	
BMI			0.845
Median	27.6	27.5	
Approach			0.002
Open (362)	87(24.0%)	275(76.0%)	
Minimally Invasive (644)	104(16.1%)	540(83.9%)	
Diabetes			0.374
No (873)	162(18.6%)	711(81.4%)	
Yes (133)	29(21.8%)	104(78.2%)	
Smoker			0.514
No (772)	150(19.4%)	622(80.6%)	
Yes (234)	41(17.5%)	193(82.5%)	
COPD			0.351
No (979)	184(18.8%)	795(81.2%)	
Yes (27)	7(25.9%)	20(74.1%)	
Hypertension			0.575
No (545)	100(18.3%)	445(81.7%)	
Yes (461)	91(19.7%)	370(80.3%)	
Metastases			0.115
No (863)	157(18.2%)	706(81.8%)	
Yes (143)	34(23.8%)	109(76.2%)	
Dyspnea			0.483
No (864)	161(18.6%)	703(81.4%)	
Yes (142)	30(21.1%)	112(78.8%)	
Steroid Use			0.354
No (829)	153(18.5%)	676(81.5%)	
Yes (177)	38(21.5%)	139(78.5%)	
ASA score			<0.001
1 or 2 (529)	77(14.6%)	452(85.4%)	
3 or 4 (477)	114(23.9%)	330(76.1%)	

Table 2:

Multivariable Linear Regression Model Examining LOS

Multivariable Linear Regression Model LOS (N=1006)				
Variable	LOS Estimate	95% Lower	95% Upper	p-value
Epidural: Yes vs. No	−0.3	−0.9	0.4	0.404
Approach: Minimally Invasive vs. Open	−2.2	−2.7	−1.6	<0.001
Age	0.0	0.0	0.0	0.892
BMI	0.0	−0.1	0.0	0.121
Diabetes: Yes vs. No	−0.5	−1.3	0.3	0.214
Smoker: Yes vs. No	0.3	−0.3	0.9	0.377
COPD: Yes vs. No	0.8	−0.9	2.5	0.343
Heart Failure: Yes vs. No	2.9	−0.1	5.8	0.056
Hypertension: Yes vs. No	−0.1	−0.7	0.5	0.844
Dialysis: Yes vs. No	0.3	−3.1	3.7	0.851
Ascites: Yes vs. No	0.6	−7.5	8.8	0.877
Mets: Yes vs. No	0.9	0.1	1.7	0.021
Dyspnea: Yes vs. No	0.9	0.1	1.7	0.035
Functions Status: Partially Dependent vs. Independent	1.5	−1.5	4.5	0.324
Steroid: Yes vs. No	0.0	−0.8	0.7	0.892
ASA: 3or4 vs. 1or2	0.6	0.0	1.2	0.046

Table 3:

Multivariable Linear Regression Model Examining LOS in Minimally Invasive Cases

Multivariable Linear Regression Model LOS: Minimally Invasive Only (N=644)				
Variable	LOS Estimate	95% Lower	95% Upper	p-value
Epidural: Yes vs. No	-0.3	-1.0	0.5	0.458
Age	0.0	0.0	0.0	0.094
BMI	0.0	-0.1	0.0	0.055
Diabetes: Yes vs. No	-0.2	-1.1	0.7	0.689
Smoker: Yes vs. No	0.5	-0.2	1.1	0.183
COPD: Yes vs. No	-0.8	-2.8	1.3	0.472
Heart Failure: Yes vs. No	-0.2	-3.7	3.3	0.911
Hypertension: Yes vs. No	0.3	-0.3	1.0	0.301
Dialysis: Yes vs. No	-1.0	-5.0	3.0	0.612
Mets: Yes vs. No	0.8	-0.2	1.8	0.123
Dyspnea: Yes vs. No	1.1	0.2	1.9	0.016
Functions Status: Partially Dependent vs. Independent	0.5	-2.9	4.0	0.768
Steroid: Yes vs. No	-0.1	-0.9	0.7	0.780
ASA: 3or4 vs. 1or2	0.3	-0.3	0.9	0.321

Table 4:

Multivariable Linear Regression Model Examining LOS in Open Cases

Multivariable Linear Regression Model LOS: Open Only (N=362)				
Variable	LOS Estimate	95% Lower	95% Upper	p-value
Epidural: Yes vs. No	-0.3	-1.6	1.0	0.656
Age	0.0	0.0	0.1	0.225
BMI	0.0	-0.1	0.1	0.701
Diabetes: Yes vs. No	-0.8	-2.3	0.8	0.345
Smoker: Yes vs. No	-0.2	-1.5	1.1	0.779
COPD: Yes vs. No	2.1	-0.8	5.0	0.159
Heart Failure: Yes vs. No	6.4	1.1	11.6	0.018
Hypertension: Yes vs. No	-0.7	-1.9	0.5	0.246
Dialysis: Yes vs. No	1.3	-5.0	7.6	0.683
Mets: Yes vs. No	1.0	-0.2	2.3	0.108
Dyspnea: Yes vs. No	0.7	-0.9	2.4	0.372
Functions Status: Partially Dependent vs. Independent	1.3	-4.2	6.8	0.636
Steroid: Yes vs. No	-0.1	-1.6	1.4	0.896
ASA: 3or4 vs. 1or2	1.1	-0.1	2.3	0.068

Table 5:

Multivariable Linear Regression Model Examining Oral Morphine Equivalents Consumed in the First 48 Hours (MME48)

Multivariable Linear Regression Model MME48 (N=497)				
Variable	MME48 Estimate	95% Lower	95% Upper	p-value
Epidural: Yes vs. No	37.0	-27.1	101.1	0.257
Approach: Minimally Invasive vs. Open	-101.7	-155.3	-48.1	<0.001
Age	-7.7	-9.6	-5.7	<0.001
BMI	0.8	-3.0	4.5	0.689
Diabetes: Yes vs. No	24.6	-52.6	101.8	0.531
Smoker: Yes vs. No	89.0	26.4	151.5	0.005
COPD: Yes vs. No	118.2	-0.8	237.1	0.052
Hypertension: Yes vs. No	-9.9	-68.4	48.7	0.741
Mets: Yes vs. No	-26.9	-100.7	46.8	0.473
Dyspnea: Yes vs. No	-19.5	-95.7	56.7	0.616
Functions Status: Partially Dependent vs. Independent	75.6	-137.8	289.0	0.487
Steroid: Yes vs. No	15.0	-54.7	84.8	0.672
ASA: 3or4 vs. 1or2	92.0	35.7	148.4	0.001