



Ropivacaine-Epinephrine-Clonidine-Ketorolac Cocktail as a Local Anesthetic for Lumbar Decompression Surgery: A Single Institutional Experience

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■ **OBJECTIVE:** The goal of this study is to discuss our initial experience with a multimodal opioid-sparing cocktail containing ropivacaine, epinephrine, clonidine, and ketorolac (RECK) in the postoperative management of lumbar decompression surgeries.

■ **METHODS:** Patients were either administered no local anesthetic at the incision site or were administered a weight-based amount of RECK into the paraspinal musculature and subdermal space surrounding the operative site once the fascia was closed. We performed a retrospective chart review of all patients 18 years of age or older undergoing lumbar laminectomy and lumbar discectomy surgeries between December 2019 and April 2021. Outcomes including total opioid use, measured as morphine milligram equivalent, length of stay, and postoperative visual analog scores for pain, were collected. Relationships between variables were analyzed with Student's *t*-test, chi-square tests, and Fisher exact tests.

■ **RESULTS:** A total of 121 patients undergoing 52 lumbar laminectomy and 69 lumbar discectomy surgeries were identified. For lumbar laminectomy, patients who were administered RECK had decreased opioid use in the postoperative period (11.47 ± 12.32 vs. 78.51 ± 106.10 morphine milligram equivalents, $P = 0.019$). For patients undergoing lumbar discectomies, RECK administration led to a shorter length of stay (0.17 ± 0.51 vs. 0.79 ± 1.45 days, $P = 0.019$)

and a lower 2-hour postoperative pain score (3.69 ± 2.56 vs. 5.41 ± 2.28 , $P = 0.006$).

■ **CONCLUSIONS:** The RECK cocktail has potential to be an effective therapeutic option for the postoperative management of lumbar decompression surgeries.

INTRODUCTION

Opioids are widely used for pain management. Although pain relief is an essential factor for improving quality of life, the overuse of opioids has led to a national epidemic in the United States causing detrimental economic and health ramifications.¹ The total economic burden of the opioid epidemic has been estimated to exceed \$1.0 trillion in 2017.² A large portion of this cost is due to long- and short-term health consequences of opioid misuse contributing to reduced quality of life and life lost to opioid overdose.^{1,2}

Back pain is one of the leading medical problems with studies showing an estimated prevalence up to 50% for all adults in the United States.^{3,4} The management of back pain has relied heavily on opioids, and the use of opioids continues to rise.³ Patients with chronic and acute back pain are both typically treated with a conservative approach, which involves pain management with opioids, before moving toward surgical treatment.^{5,6} Therefore many patients undergoing spine surgery already have an exposure to opioids by the time they have surgery.⁶ Exposure to opioids continues in the postoperative period for pain control

Key words

- Discectomy
- Laminectomy
- Multimodal pain relief
- Opioid sparing
- Postoperative pain
- Spine surgery

Abbreviations and Acronyms

- LOS:** Length of stay
MME: Morphine milligram equivalent
PACU: Postanesthesia care unit
RECK: Ropivacaine, epinephrine, clonidine, and ketorolac

TKA: Total knee arthroplasty

VAS: Visual analog score

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and management of complications.^{6,7} Studies have shown that increased preoperative and perioperative opioid use is associated with increased rates of postoperative opioid use.^{5,7} Decreasing overall opioid use is important to decrease the amount of opioid related complications and development of opioid dependence.

Despite the widespread use of opioids for postoperative pain and back pain relief, there is varied evidence demonstrating the effectiveness of opioids for pain control following spine surgery.^{5,6} Nevertheless, the treatment of pain after spine surgery remains essential. Pain relief is important to decrease psychologic distress, but its proper management also promotes early mobilization and reduces hospital length of stay, which both act to decrease postoperative complications and increase rate of recovery.⁸⁻¹⁰ Various studies have examined multimodal treatment options including enhanced recovery after surgery protocols and the use of multimodal nonopioid analgesia to decrease overall opioid use.^{5,10,11} The use of multimodal opioid-sparing analgesia has been widely used in orthopedic arthroplasty surgeries. This method has been demonstrated to be effective in decreasing both postoperative pain and postoperative opioid consumption.^{12,13} One of the most successful anesthetic cocktails is made from the combination of ropivacaine, epinephrine, clonidine, and ketorolac (RECK).¹² To the best of our knowledge, the use RECK has not been shown in the literature for pain control in spine surgeries.

We discuss our initial experience with the use of opioid sparing RECK cocktail in elective lumbar laminectomy and lumbar discectomy surgeries at our institution.

METHODS

Inclusion/Exclusion Criteria

This study was approved by the institutional medical research review board at Baylor Scott and White (Institutional Review Number: 021–239). A retrospective chart review of patients 18 years of age or older undergoing elective lumbar discectomy or lumbar laminectomy surgeries between December 2019 and April 2021 was completed. **Figure 1** shows specific details of the inclusion and exclusion criteria for this study. Any patients who had surgery for trauma, secondary neoplasms, or developed postoperative complications were excluded to prevent confounding factors. A total of 121 patients who fit our study criteria. Fifty-one patients received the RECK cocktail, and 70 patients received no local anesthesia.

Analgesic Protocol

Patients were administered RECK cocktail at the surgical site based on surgeon preference. RECK was received in a prefilled 50-mL syringe containing 123 mg ropivacaine, 0.25 mg epinephrine, 0.04 mg clonidine, and 15 mg ketorolac in a sodium chloride solution. The primary surgeon used a 22-gauge spinal needle for local infiltration into the paraspinal musculature and subdermal space surrounding the operative site once the fascia was closed and before wound closure was completed. One syringe was used for patients weighing 35–60 kg, and 2 syringes were used for larger patients. The no-local-patient group was not administered

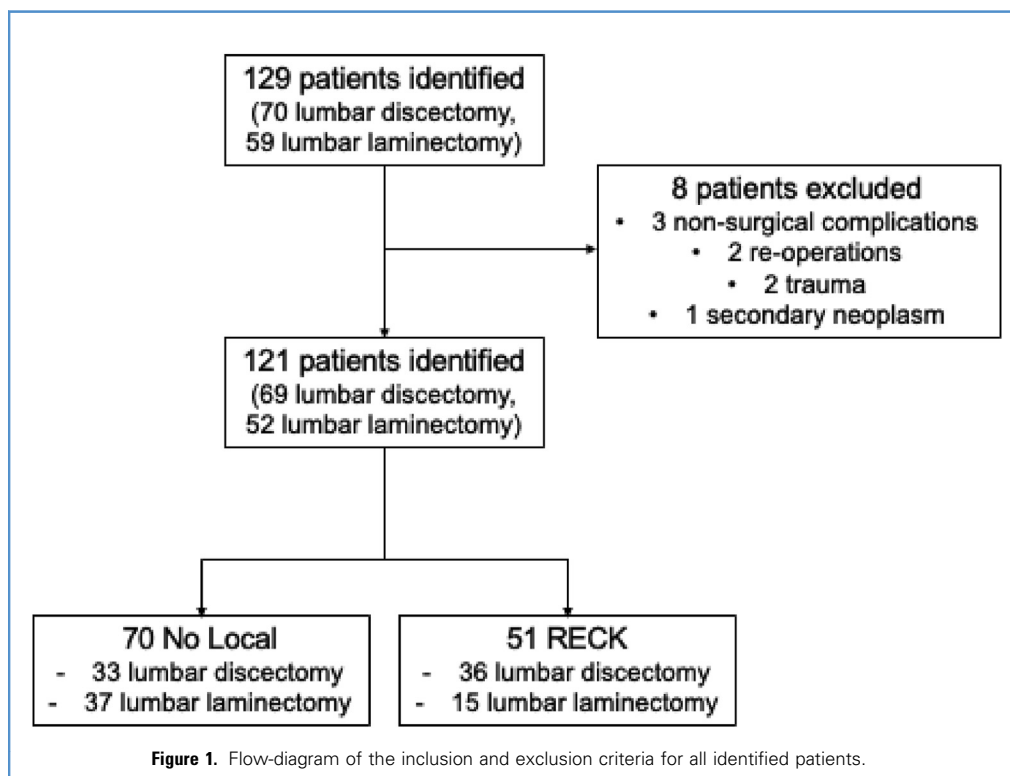


Table 1. Baseline Patient Characteristics for Lumbar Laminectomy

Variable	Study Group		P Value
	RECK (n = 15)	No Local (n = 37)	
Lumbar laminectomy			
Age, years (mean)	66.47 ± 14.19	58.18 ± 17.72	0.114*
Number of male patients (%)	8 (53.3%)	27 (73.0%)	0.203†
BMI (mean)	28.67 ± 4.35	31.36 ± 5.33	0.090*
Number of patients with preoperative opioids (%)	6 (40.0%)	10 (27.0%)	0.652†
Preoperative VAS pain score (mean)	6.86 ± 2.54	6.47 ± 2.56	0.634*
Number of patients with 1-level surgery (%)	6 (40.0%)	18 (48.6%)	0.881†
Number of patients with 2-level surgery (%)	7 (46.7%)	13 (35.1%)	
Number of patients with 3-level surgery (%)	1 (6.67%)	4 (10.8%)	
Number of patients with 4-level surgery (%)	1 (6.67%)	2 (5.41%)	

RECK, ropivacaine, epinephrine, clonidine, and ketorolac; BMI, body mass index; VAS, visual analog scale.
 *Student's *t*-test.
 †Chi-square or Fisher exact test.

any form of local anesthesia before an incision was made or after the fascia was closed.

Following surgery, patients were transferred to the post-anesthesia care unit (PACU). Patients were either discharged from the PACU or transferred to the general medical-surgical floor. All patients were given opioid medications postoperatively on an as-needed basis to control pain as tolerated.

Variables Collected

Patient demographics included age, body mass index, gender, use of preoperative opioids at the most recent surgical consult visit preoperatively, and preoperative visual analog score (VAS) for pain. VAS pain scores are reported on a scale from 0–10, with 0 being no pain and 10 being the worst possible pain. The number of surgical levels operated on are also reported. Postoperative outcomes measured included total hospital length of stay (LOS) and patient-reported VAS pain scores at 2 hours, 4 hours, and 6 hours after surgery. The total amount of opioid medication, from the time of admission to PACU until discharge, is reported as morphine milligram equivalents (MMEs).

Statistical Analysis

All statistics were completed using SPSS version 28.0 (IBM Corp.), and statistical significance was set to 95%. Continuous data are represented as mean ± standard deviation. The Student's *t*-test, chi-square test, and Fisher exact test were used as appropriate to analyze all variables and compare outcomes.

RESULTS

Patient Characteristics

A total of 121 patients undergoing 52 lumbar laminectomy and 69 lumbar discectomy surgeries were identified. There were 51 (15 lumbar laminectomy and 36 lumbar discectomy) patients who

received the RECK cocktail and 70 (37 lumbar discectomy and 33 lumbar laminectomy) patients who did not receive any local anesthesia. There was a significant difference between the age of the patients in the lumbar laminectomy and lumbar discectomy patients (60.58 ± 17.07 vs. 37.13 ± 12.86 years, $P < 0.001$), and a Fisher exact test found a difference in association between the type of surgery and the number of surgical levels operated on ($P < 0.001$). Therefore the lumbar laminectomy and lumbar discectomy categories were analyzed separately to prevent confounding factors.

There was no significant difference between the RECK and no local patients in both the lumbar laminectomy (Table 1) and lumbar discectomy (Table 2) groups in terms of age, gender, percent of patients on preoperative opioids, and preoperative VAS pain scores. There was also no significant association between the number of surgical levels and the administration of RECK in either lumbar laminectomy or discectomy groups. So, we considered the RECK and no-RECK patients equivalent in terms of baseline characteristics within the surgical group and did not control for any of these factors as potential confounders in further statistical analysis.

Postoperative Characteristics

The postoperative LOS, MME, and 2-hour, 4-hour, and 6-hour VAS pain scores were analyzed (Table 3).

Lumbar Laminectomy

Patients undergoing lumbar laminectomies who received RECK were found to have a lower MME postoperatively than those who did not receive RECK. Patients who were administered RECK received 11.47 ± 12.32 MMEs compared with 78.51 ± 106.10 MMEs in the non-RECK patients ($P = 0.019$). The LOS of patients who received RECK (0.73 days ± 1.62 days) compared with those who did not (1.73 ± 1.68 days) reached near significance ($P = 0.056$).

Table 2. Baseline Patient Characteristics for Lumbar Discectomy

	Variable	RECK (n = 36)	No Local (n = 33)	P Value
Lumbar discectomy	Age, years	37.11 ± 14.34	37.15 ± 11.23	0.990*
	Number of male patients (%)	25 (69.4%)	22 (66.7%)	0.805†
	BMI	29.13 ± 4.66	29.69 ± 4.53	0.618*
	Number of patients with preoperative opioids (%)	12 (33.3%)	9 (27.3%)	0.585†
	Preoperative VAS pain score	6.39 ± 2.42	6.85 ± 2.28	0.420†
	Number of patients with 1-level surgery	32 (88.9%)	29 (87.9%)	0.846†
	Number of patients with 2-level surgery	4 (11.1%)	3 (9.1%)	
	Number of patients with 3-level surgery	0 (0%)	1 (3.03%)	
Number of patients with 4-level surgery	0 (0%)	0 (0%)		

RECK, ropivacaine, epinephrine, clonidine, and ketorolac; BMI, body mass index; VAS, visual analog scale.

*Student's *t*-test.

†Chi-square or Fisher exact test.

There was no significant difference between 2-hour and 4-hour postoperative pain scores.

Lumbar Discectomy

Lumbar discectomy patients who received RECK had a shorter LOS compared with no-RECK patients (0.17 ± 0.51 vs. 0.79 ± 1.45 , $P = 0.019$). Patients who received RECK also had a lower 2-hour postoperative pain score than no-RECK patients (3.69 ± 2.56 vs. 5.41 ± 2.28 , $P = 0.006$). There was no significant difference in MME between the 2 groups.

Statistical analysis was not performed for the 6-hour pain scores because only 1 patient who received RECK in the lumbar laminectomy group and 1 patient in the lumbar discectomy group had a documented 6-hour pain score. Other patients were either missing 6-hour pain scores in the chart or were discharged before this time point.

DISCUSSION

Our study suggests that the use of RECK decreased opioid use in the postoperative period for patients undergoing lumbar laminectomies compared with patients who received no local anesthetic. In lumbar discectomy patients the use of opioids remained the same, but there was a decrease in the LOS and 2-hour pain scores with RECK administration.

There are several potential reasons for the differences in outcomes between the lumbar laminectomy and lumbar discectomy patients. The main differences between these 2 groups in our study is the average age and a difference in association between the number of surgical levels operated on. The lumbar discectomy patients had an average age 23.45 years younger than the lumbar laminectomy patients. Other factors that can influence the outcome factors, such as body mass index, preoperative pain scores, and preoperative opioid use, were statistically similar between RECK and non-RECK patients. The differences in age between the 2 cohorts is important because age has been shown to

influence the amount of opioids used postoperatively, LOS, and VAS pain scores.¹⁴⁻¹⁶ Similarly, the number of surgical levels operated on has been shown to affect postoperative pain and chronic opioid use.¹⁷ Another potential reason for the differences in outcomes is that the LOS was longer for lumbar laminectomy patients than lumbar discectomy. Since RECK has been shown to provide similar benefits as liposomal bupivacaine, which is designed for longer-term benefits, we saw the benefits of RECK in terms of decreased opioid use for the patients with a longer LOS.^{18,19} The longer-term benefits of RECK can be better studied in patients who undergo spine fusion or deformity surgeries since they have longer LOS in the hospital.

Despite the differences in the lumbar laminectomy and discectomy patients, our results show that RECK has the potential to be beneficial after lumbar decompression surgeries. In lumbar laminectomy patients, the reduced opioid use in the postoperative period can decrease opioid-related complications and opioid dependence.¹⁷ In lumbar discectomy patients, RECK was beneficial in decreasing 2-hour postoperative pain and LOS, which will allow for earlier mobility and quicker recovery. Even though there were no differences in the other outcomes, our data suggest that the administration of RECK cocktail can provide benefits to patients in the postoperative compared with no local anesthesia.

The RECK cocktail is unique because it includes commonly used agents (ropivacaine, epinephrine, and ketorolac), but it also includes the use of the alpha-2 adrenergic agonist clonidine.²⁰ Studies have shown that clonidine can prolong nerve blockade and lead to enhanced pain control due to both its vasoconstricting properties and its direct effect on peripheral nerves.²⁰⁻²² All previous studies demonstrating the efficacy of the RECK cocktail have involved arthroplasty surgeries.^{13,23-26} Kelley et al²³ performed a randomized double-blinded study investigating the efficacy of the RECK cocktail, as well as other combinations of RECK components, as a periarticular injection in total knee arthroplasties (TKAs). They found that compared with

Table 3. Postoperative Characteristics

Variable	Study Group				P Value	
	RECK	Number of Patients Analyzed	No Local	Number of Patients Analyzed		
Lumbar laminectomy	LOS, days (mean)	0.73 ± 1.62	15	1.73 ± 1.68	37	0.056*
	MME, mg (mean)	11.47 ± 12.32	15	78.51 ± 106.10	37	0.019*
	2-hour VAS score (mean)	3.79 ± 2.26	14	5.29 ± 2.45	28	0.062*
	4-hour VAS score (mean)	4.00 ± 2.18	9	4.13 ± 3.36	23	0.915*
	6-hour VAS score (mean)	4.00 ± 0	1	4.53 ± 2.34	19	—†
Lumbar discectomy	LOS, days (mean)	0.17 ± 0.51	36	0.79 ± 1.45	33	0.019*
	MME, mg (mean)	21.98 ± 53.40	36	46.40 ± 92.18	33	0.178*
	2-hour VAS score (mean)	3.69 ± 2.56	36	5.41 ± 2.28	29	0.006*
	4-hour VAS score (mean)	5.38 ± 2.26	8	6.43 ± 2.79	14	0.375*
	6-hour VAS score (mean)	7.00 ± 0	1	7.00 ± 1.73	9	—†

Bold indicates $P < 0.05$.
 LOS, length of stay; MME, morphine milligram equivalent; VAS, visual analog scale.
 *Student t-test.
 †Student's t-test was not performed for the 6-hour pain scores since the RECK category only had 1 reported score in the chart for both lumbar laminectomy and discectomy patients.

the control (ropivacaine and epinephrine alone), RECK had greater early postoperative pain control.^{23,24} Another randomized prospective study compared RECK against traditional adductor canal block after TKA. This study also found that RECK provides superior early postoperative pain control.²⁵

Bupivacaine is a local anesthetic commonly used for short-term pain relief postoperatively. Recently, bupivacaine has been developed into a liposomal form, allowing for the medication to release slowly and provide pain control over a longer time period. This has several benefits including decreased postoperative opioid use and postoperative pain.^{24,26} However, the cost of liposomal bupivacaine is significantly higher than RECK and other pain management options.²⁶ Prospective studies have shown that compared with liposomal bupivacaine, RECK provides similar or superior benefits in terms of postoperative pain control, functional recovery, and decreased opioid use after TKA.^{26,27} Therefore RECK is potentially more effective than liposomal bupivacaine and at a much lower price point.

Limitations

This study has several limitations. It is a retrospective study, and the administration of RECK was not randomized. There was no difference in demographics and other factors included in this study between RECK and no-RECK patients. Our study also included a relatively small patient population of 120 patients. This, combined with the fact that our hospital is in a relatively rural area, makes our initial study less generalizable to the entire population. This study also did not consider other factors that can potentially affect the outcome variables we analyzed including previous surgeries and other health comorbidities. Our study also

did not track patient pain scores and opioid use after they were discharged from the hospital. Despite these limitations, this study provides evidence for RECK in spine surgeries so that future randomized, double-blinded studies can be completed.

CONCLUSION

Our data suggest that the RECK cocktail has potential to be an effective opioid-sparing therapeutic option in postoperative management of lumbar decompression surgeries. However, further investigation is required before establishing the role of RECK for the postoperative management in spine surgery and compare with other forms of postoperative pain control. Future studies will continue looking at the effects of RECK in other types of spine surgeries, investigate the efficacy of RECK compared with other forms of local anesthetics, and lay the groundwork for future prospective clinical trials.

CRedit AUTHORSHIP CONTRIBUTION STATEMENT

Lokeshwar S. Bhenderu: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Kristopher A. Lyon:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Jose M. Soto:** Formal analysis, Methodology, Writing – original draft. **William Richardson:** Writing – original draft. **Ronak Desai:** Conceptualization, Writing – review & editing. **Mark Rahm:** Conceptualization, Writing – review & editing. **Jason Huang:** Conceptualization, Writing – review & editing.

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