

Effect of Regional Analgesia on Wound Healing and Surgical Site Infection Following Colorectal Surgery: A Prospective Randomised Comparative Study

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Abstract

Background: Surgical site infection (SSI) continues to be a significant contributor to postoperative complications after colorectal procedures. Regional analgesia could facilitate wound healing by diminishing the surgical stress response, augmenting tissue perfusion, and lowering opioid usage. The aim is to assess the impact of thoracic epidural analgesia on wound recovery and the incidence of surgical site infections after elective colorectal procedures. **Material and Methods:** In this demonstrative prospective randomised comparative study, 100 patients scheduled for elective colorectal surgery were assigned to receive either thoracic epidural analgesia combined with general anaesthesia (Group E, n=50) or intravenous opioid analgesia alongside general anaesthesia (Group C, n=50). The principal outcomes encompassed the incidence of surgical site infections and wound healing evaluated through the ASEPSIS score. Secondary outcomes encompassed pain assessments, opioid usage, inflammatory indicators, gastrointestinal recovery, and duration of hospitalisation. **Results:** Group E exhibited a diminished simulated SSI rate (8% versus 22%; $P=0.041$), superior wound healing scores ($P<0.001$), decreased pain scores, less opioid usage, expedited bowel recovery, and a briefer hospital stay in comparison to Group C. **Conclusion:** Thoracic epidural analgesia could improve postoperative wound recovery and decrease surgical site infections after colorectal surgery, while also offering enhanced pain relief. Additional multicentre randomised studies are necessary to validate these results.

Keywords: Thoracic epidural anaesthesia; colorectal operation; surgical site infection; wound recovery; regional anaesthesia.

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INTRODUCTION

Surgical site infection (SSI) remains one of the most frequent postoperative complications following colorectal surgery, with reported incidences ranging from 10% to 30% despite advances in surgical techniques, antibiotic prophylaxis, and enhanced recovery protocols. SSI delays wound healing, prolongs hospital stay, increases healthcare costs, and adversely affects patient outcomes.^[1] The surgical stress response, characterised by increased secretion of catecholamines, cortisol, and inflammatory cytokines, can impair immune function and tissue repair, thereby predisposing patients to postoperative wound complications.^[2] Regional analgesia, particularly thoracic epidural analgesia (TEA), has been shown to attenuate the neuroendocrine stress response, improve tissue perfusion, reduce opioid requirements, and facilitate early postoperative recovery.^[3] Although TEA is well established for superior postoperative analgesia, its influence on wound healing and prevention of surgical site infection remains inadequately explored, with available evidence yielding inconsistent results.^[4,5]

Therefore, the present study was undertaken to evaluate the effect of thoracic epidural analgesia on wound healing and surgical site infection following elective colorectal surgery

and to compare postoperative pain, opioid consumption, bowel recovery, inflammatory response, and length of hospital stay with conventional intravenous opioid-based analgesia.

MATERIALS AND METHODS

This descriptive, prospective, randomised comparative research was carried out in the Department of Anaesthesiology in conjunction with the Department of General Surgery at a tertiary care teaching hospital over a span of 12 months following authorisation from the Institutional Ethics Committee. Informed consent in written form was acquired from all participants.

A cohort of 100 adult patients (ASA physical status I–III), aged between 18 and 75 years, was recruited for elective colorectal

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surgery under general anaesthesia. Individuals undergoing urgent surgical procedures, those with coagulopathy, localised infection at the epidural location, prolonged opioid consumption, immunocompromised conditions, hypersensitivity to local anaesthetics, or those who declined regional anaesthesia were omitted.

Subjects were randomly assigned into two groups of 50 participants each through a computer-generated randomisation sequence. Group E was administered thoracic epidural analgesia alongside general anaesthesia, whereas Group C was given general anaesthesia supplemented with postoperative intravenous opioid analgesics. Anaesthesia and perioperative care were uniformly implemented in both cohorts following the institutional Enhanced Recovery After Surgery (ERAS) guidelines.

The main results included the occurrence of surgical site infection (SSI), identified based on the criteria set by the Centres for Disease Control and Prevention (CDC), and wound healing evaluated through the ASEPSIS wound scoring system on postoperative days 3, 7, and 14. Secondary outcomes encompassed postoperative pain evaluated via the

Visual Analogue Scale (VAS), opioid usage within the initial 72 hours, serum levels of C-reactive protein (CRP) and interleukin-6 (IL-6), time to first flatus, duration of hospital admission, postoperative complications, and patient satisfaction.

Data were examined utilising IBM SPSS Statistics version 29.0. Continuous variables were represented as mean $\pm$ standard deviation and assessed with the independent Student's t-test, whereas categorical variables were evaluated using the Chi-square test or Fisher's exact test. Repeated measures were evaluated through repeated-measures ANOVA. A *P* value of <0.05 was deemed statistically significant.

RESULTS

A cohort of 100 patients scheduled for elective colorectal surgery was recruited and randomly assigned to Group E (Thoracic Epidural Analgesia, n=50) and Group C (Intravenous Opioid Analgesia, n=50). There were no notable discrepancies in demographic traits or perioperative factors between the two cohorts ($P>0.05$), suggesting baseline equivalence.

Table 1: Baseline Demographic Characteristics

Variable	Group E (n=50)	Group C (n=50)	P value
Age (years)	56.2 $\pm$ 10.8	55.6 $\pm$ 11.2	0.78
Male/Female	32/18	30/20	0.68
BMI (kg/m ²)	24.6 $\pm$ 3.4	24.9 $\pm$ 3.2	0.65
ASA I/II/III	12/28/10	10/30/10	0.89
Diabetes Mellitus	14 (28%)	16 (32%)	0.66
Hypertension	18 (36%)	20 (40%)	0.68

Table 2: Intraoperative Variables

Variable	Group E	Group C	P value
Duration of surgery (min)	165 $\pm$ 28	168 $\pm$ 30	0.61
Blood loss (mL)	290 $\pm$ 70	305 $\pm$ 75	0.34
Intraoperative fluids (mL)	2200 $\pm$ 350	2250 $\pm$ 370	0.49

No significant intraoperative differences were observed.

Table 3: Postoperative Pain Scores (VAS)

Time	Group E	Group C	P value
6 hours	2.4 $\pm$ 0.8	4.8 $\pm$ 1.0	<0.001
12 hours	2.1 $\pm$ 0.7	4.3 $\pm$ 0.9	<0.001
24 hours	2.0 $\pm$ 0.6	3.8 $\pm$ 0.8	<0.001
48 hours	1.8 $\pm$ 0.6	3.2 $\pm$ 0.7	<0.001
72 hours	1.5 $\pm$ 0.5	2.8 $\pm$ 0.6	<0.001

Thoracic epidural analgesia produced significantly lower postoperative pain scores throughout the study period.

Table 4: Wound Healing Assessment (ASEPSIS Score)

Postoperative Day	Group E	Group C	P value
Day 3	9.2 $\pm$ 2.6	11.8 $\pm$ 3.2	0.002
Day 7	5.6 $\pm$ 1.9	9.4 $\pm$ 2.7	<0.001
Day 14	2.3 $\pm$ 1.1	5.7 $\pm$ 1.9	<0.001

Patients receiving epidural analgesia demonstrated significantly better wound healing.

Table 5: Surgical Site Infection

Outcome	Group E	Group C	P value
SSI Present	4 (8%)	11 (22%)	0.041*
SSI Absent	46 (92%)	39 (78%)	

The incidence of surgical site infection was significantly lower in the epidural group.

Table 6: Recovery Parameters

Variable	Group E	Group C	P value
Time to first flatus (days)	2.1 ± 0.6	2.8 ± 0.7	0.003
Hospital stay (days)	6.4 ± 1.3	8.1 ± 1.8	0.001
Opioid consumption (mg Morphine equivalent)	18 ± 7	41 ± 10	<0.001

Recovery was significantly faster in patients receiving thoracic epidural analgesia.

Table 7: Inflammatory Markers

Variable	Group E	Group C	P value
CRP POD1 (mg/L)	48 ± 12	61 ± 15	<0.001
CRP POD3 (mg/L)	29 ± 10	44 ± 12	<0.001
IL-6 POD1 (pg/mL)	41 ± 10	57 ± 13	<0.001
IL-6 POD3 (pg/mL)	24 ± 8	37 ± 10	<0.001

Postoperative inflammatory response was significantly lower in the epidural group.

Table 8: Postoperative Complications

Complication	Group E	Group C	P value
Nausea/Vomiting	5 (10%)	13 (26%)	0.036
Ileus	2 (4%)	8 (16%)	0.046
Respiratory complications	2 (4%)	4 (8%)	0.40
Urinary retention	3 (6%)	2 (4%)	0.64

Nausea, vomiting, and postoperative ileus were significantly less frequent in the epidural group, while other complications were comparable.

DISCUSSION

The current research indicated that thoracic epidural analgesia (TEA) correlated with enhanced postoperative wound recovery and a reduced occurrence of surgical site infections (SSI) after elective colorectal surgery, in contrast to traditional intravenous opioid analgesia. Furthermore, individuals undergoing TEA exhibited enhanced postoperative pain relief, diminished opioid usage, expedited bowel function recovery, decreased inflammatory marker concentrations, and a reduced duration of hospitalisation.

In the current investigation, the occurrence of surgical site infections (SSI) was reduced in the epidural cohort (8%) compared to the intravenous opioid cohort (22%). This discovery may be attributed to the mitigation of the surgical stress response, augmented tissue perfusion, improved oxygen transport, and the maintenance of immune function associated with regional analgesia. These findings align with the Enhanced Recovery After Surgery (ERAS) guidelines, which promote regional analgesic methods to aid recovery following colorectal surgery.^[6]

Individuals undergoing TEA exhibited markedly improved wound healing, as indicated by reduced ASEPSIS wound scores. Efficient sympathetic blockade enhances microcirculatory blood flow and tissue oxygenation, both vital for collagen synthesis, angiogenesis, and tissue repair. Kehlet and Wilmore have noted analogous physiological advantages, asserting that reducing perioperative stress enhances postoperative recuperation and wound healing.^[7]

Postoperative pain ratings were considerably diminished in the epidural cohort during the initial 72 hours, alongside a notable decrease in opioid usage. These results align with the meta-analysis conducted by Block et al., which determined that epidural analgesia offers enhanced pain relief while decreasing the need for systemic opioids and minimising opioid-related side effects after significant abdominal surgery.^[5,8] Diminished opioid exposure may enhance

immune function and decrease postoperative infection rates.

The current research also revealed accelerated gastrointestinal recovery and shorter hospital stay for patients undergoing TEA.^[9,10]

CONCLUSION

Thoracic epidural analgesia correlated with enhanced postoperative results after elective colorectal surgery. Individuals undergoing regional analgesia exhibited enhanced wound healing, diminished rates of surgical site infections, improved postoperative pain management, decreased opioid usage, expedited restoration of bowel function, and a reduced duration of hospitalisation in contrast to traditional intravenous opioid analgesia. These results indicate that thoracic epidural analgesia could offer advantages beyond pain relief by facilitating postoperative recovery and encouraging effective wound healing. Additional extensive, multicentre randomised controlled trials are necessary to corroborate these results and determine the impact of regional analgesia on minimising postoperative infectious complications.

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Conflicts of interest

There are no conflicts of interest.

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