Randomized trial comparing epidural anaesthesia and patient-controlled analgesia after laparoscopic segmental colectomy

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Background: This randomized clinical trial compared the use of thoracic epidural anaesthesia–analgesia (TEA) with morphine patient-controlled analgesia (PCA) for pain relief after laparoscopic colectomy.

Methods: Patients scheduled for segmental laparoscopic colectomy were randomized to receive TEA or PCA. Patients in the TEA group received bupivacaine and fentanyl before incision and after surgery by continuous infusion for 18 h. Patients in the PCA group self-administered morphine using an intravenous pump. The postoperative care plan was otherwise identical for the two groups. Postoperative pain was measured during ambulation using a visual analogue pain score.

Results: The study included 38 patients (18 TEA, 20 PCA), 16 of whom underwent right hemicolectomy or ileocolectomy and 22 sigmoid colectomy. Operating times, patient weight and distribution of American Society of Anesthesiologists grade were similar in the two groups. The mean(s.e.m.) total dose of drugs administered was 64(41) mg morphine in the PCA group, and 79(42) mg bupivacaine and 205(140) µg fentanyl in the TEA group. Postoperative pain scores were significantly better in the TEA group at 6 h (mean(s.e.m.) 2.2(0.4) versus 6.6(0.5) with PCA; P = 0.001) and 18 h (2.2(0.3) versus 4.0(0.4); P = 0.003). Hospital stay was similar in the two groups.

Conclusion: TEA significantly improved early analgesia following laparoscopic colectomy but did not affect the length of hospital stay.

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Introduction

Previous work in this department suggested that use of an anaesthesia–analgesia programme based on bupivacaine and fentanyl administered epidurally (thoracic epidural anaesthesia–analgesia; TEA) resulted in a shorter hospital stay after laparoscopic colectomy than use of patient-controlled analgesia (PCA) with intravenous morphine1. Bardram et al2 reported on eight patients who were discharged 2–3 days after laparoscopic colectomy, but no control group was studied. A randomized clinical trial that compared morphine PCA and bupivacaine TEA with morphine PCA favoured the epidural group, but there was no significant difference in return of bowel function after operation3. The present randomized clinical trial was designed to compare the relative benefits of TEA and PCA after segmental laparoscopic colectomy.

Patients and methods

All patients scheduled for segmental laparoscopic colectomy (right hemicolectomy or ileocolectomy, or sigmoid colectomy) between January 2001 and February 2002 were eligible for the study. Patients who declined to participate, had protocol violations, or whose operation was converted to open surgery after randomization were excluded from analysis. Patients were randomized to one of the two study groups by computer-generated random number after giving informed consent. This study was approved by the Cleveland Clinic Foundation Institutional Review Board.
All patients underwent mechanical bowel preparation consisting of a clear liquid diet for 24 h before operation and 90 ml Fleet's Phosphosoda™ (C. B. Fleet, Lynchburg, Virginia, USA) was administered the afternoon before surgery. Prophylactic cefuroxime 1 g and metronidazole 500 mg were administered intravenously to each patient 1 h before the procedure. A urinary catheter was inserted at surgery and removed the following morning. A full liquid diet was available at the earliest mealtime following operation and was changed to a general diet at the patient's discretion. Criteria for discharge from hospital in both groups of patients included tolerance of three consecutive general meals without nausea or vomiting, adequate pain control with oral analgesics, and passage of flatus. Length of hospital stay was defined as the number of nights spent in hospital from day of operation until discharge. Readmission of hospital stay was defined as the number of nights spent in hospital after operation until discharge. 

Data analysis

Data collected included age, sex, American Society of Anesthesiologists grade, weight, type of colectomy, indication for surgery, amount of analgesic administered, complications, pain scores, length of hospital stay and incidence of readmission to hospital within 30 days. All descriptive statistics are presented as mean(s.e.m.). Statistical analysis consisted of paired Student's t test, ANOVA and Fisher's exact test as appropriate. P < 0.05 was considered statistically significant. Sample size and statistical power analysis revealed that, with an α level of 0.05 and a power of 85 per cent, 18 patients per group would be needed to detect a difference in length of hospital stay of at least 1 day.

Results

Forty-seven patients were randomized during the study but four (two TEA and two PCA) had no resection or a second surgical procedure during their hospital stay, and five (three TEA and two PCA) had protocol violations and were excluded from subsequent analysis. The remaining 38 patients, 18 in the TEA group and 20 in the PCA group, were evaluated (Fig. 1). The demographic data are shown in Table 1. There were no significant differences in age, sex, weight or type of segmental resection between the two groups. There were no postoperative in-hospital complications in either group. Three patients were readmitted within 30 days in the TEA group (two with pelvic abscesses that were drained percutaneously and one bolus capability of 1–2 ml with a 15-min lock-out period. The epidural catheter and PCA pump were removed on the first postoperative day, 18 h after completion of the surgical procedure. The oral analgesic regimen consisted of oxycodone 4·5 mg and aspirin 325 mg every 3 h as required and diclofenac 50 mg every 8 h. Patients in the PCA group received the same antiemetic protocol, perioperative non-steroidal analgesics, and oral narcotics after surgery. Extra morphine (1–4 mg intravenously every 3–4 h) was available to both groups for breakthrough pain. Postoperative pain control was monitored by the Pain Management Service and analgesics were adjusted as needed. Maximal postoperative pain during ambulation was measured at 6, 12, 18, 24 and 36 h using a 10-cm visual analogue pain score. Postoperative nausea was defined as that sufficient to warrant treatment with one or more additional doses of ondansetron. Episodes of emesis were recorded and were treated with ondansetron. No patient required a nasogastric tube.
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Assessed for eligibility \( (n = 47) \)

Randomized \( (n = 47) \)

Allocated to TEA \( (n = 23) \)

Received allocated TEA \( (n = 23) \)

Allocated to PCA \( (n = 24) \)

Received allocated PCA \( (n = 24) \)

Discontinued study \( (n = 5) \)

Protocol violation \( (n = 3) \)

No resection or second operation during hospital stay \( (n = 2) \)

Discontinued study \( (n = 4) \)

Protocol violation \( (n = 2) \)

No resection or second operation during hospital stay \( (n = 2) \)

Analysed for primary endpoint (length of stay) \( (n = 18) \)

Analysed for primary endpoint (length of stay) \( (n = 20) \)

![Study design diagram](image)

**Table 1** Demographic data

<table>
<thead>
<tr>
<th></th>
<th>TEA ( (n = 18) )</th>
<th>PCA ( (n = 20) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)*</td>
<td>53(16)</td>
<td>54(13)</td>
</tr>
<tr>
<td>Sex ratio (M : F)</td>
<td>9 : 11</td>
<td>12 : 8</td>
</tr>
<tr>
<td>Right colectomy or ileocolectomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyp or cancer</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Crohn’s disease</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sigmoid resection</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Diverticular disease</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Polyp or cancer</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Weight (kg)*</td>
<td>80(25)</td>
<td>80(06)</td>
</tr>
<tr>
<td>ASA grade</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>14</td>
</tr>
<tr>
<td>Operating time (min)*</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Length of hospital stay (days)*</td>
<td>2.4(0.2)</td>
<td>2.3(0.3)</td>
</tr>
</tbody>
</table>

*Values are mean(s.e.m.). TEA, thoracic epidural anaesthesia–analgesia; PCA, patient-controlled analgesia; ASA, American Association of Anesthesiologists.

Fig. 1 Study design

**Table 2** Complications associated with analgesia and postoperative pain scores

<table>
<thead>
<tr>
<th></th>
<th>TEA ( (n = 18) )</th>
<th>PCA ( (n = 20) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea or vomiting</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hypotension</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Respiratory depression</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pruritus</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Pain score (VAS)*</td>
<td>6 h</td>
<td>2.2(0.4)</td>
</tr>
<tr>
<td></td>
<td>18 h</td>
<td>2.2(0.3)</td>
</tr>
<tr>
<td></td>
<td>24 h</td>
<td>1.9(0.4)</td>
</tr>
<tr>
<td></td>
<td>36 h</td>
<td>1.7(0.3)</td>
</tr>
</tbody>
</table>

*Mean(s.e.m.) score on visual analogue scale (VAS). TEA, thoracic epidural anaesthesia–analgesia; PCA, patient-controlled analgesia. \(^{†}P = 0.001, ‡P = 0.003\) versus TEA (ANOVA).

and respiratory depression was similarly low in the two groups (Table 2).

The mean total dose of drugs administered was 64(41) mg morphine in the PCA group, and 79(42) mg bupivacaine and 205(140) µg fentanyl in the TEA group.
Pain scores were significantly lower at 6 and 18 h in the TEA group and there was a trend towards significance at 24 h (Table 2). There was no significant difference in the mean duration of hospital stay between the two groups (Table 1). All patients in both groups were discharged home and no patient required home care nursing or placement in an extended care facility.

**Discussion**

Adequate analgesia is important in reducing perioperative stress and improving postoperative rehabilitation. Standard laparotomy activates a neurohumoral stress response that includes a variety of inflammatory mediators. Laparoscopic colectomy may independently reduce postoperative inflammatory cascades and a similar reduction in the stress response to laparotomy has been demonstrated with the use of TEA. A reduction in perioperative stress and use of effective analgesia should result in fewer postoperative cardiopulmonary complications and a shorter hospital stay. In a previous study, the authors compared a group of patients who had TEA after segmental laparoscopic colectomy with a historical group who received PCA. There was a reduction in the mean length of stay of 1-1 days in the TEA group, primarily because these patients appeared to tolerate a normal diet sooner.

TEA with bupivacaine and low-dose fentanyl represents an effective means of providing analgesia after abdominal surgery. Because the technique spares the lumbar and sacral nerve routes, there is minimal risk of lower extremity motor deficits, urinary retention and hypotension compared with that after lumbar administration. TEA may reduce the incidence of cardiopulmonary complications owing to a decrease in myocardial oxygen consumption, pulmonary capillary wedge pressure and pulmonary artery pressure, and an improvement in myocardial blood flow. There is also an improvement in postoperative pulmonary function after laparotomy with TEA because the better analgesia results in improvements in forced vital capacity and forced expiratory volumes at 1 s. Whether TEA minimizes postoperative ileus as a result of the inhibition of sympathetic outflow from the T5–L2 levels while sparing sacral parasympathetic stimulus is less certain, particularly after laparoscopic colectomy. However, after open surgery there is a significant body of evidence to suggest that postoperative ileus can be reduced effectively by TEA.

Epidural anaesthesia–analgesia appears to be an important component of the perioperative care plan in some fast-track programmes for open colectomy. The authors’ previous work suggested a similar benefit in terms of length of hospital stay after laparoscopic colectomy. Bardram et al. recorded a hospital stay of 2–3 days in a consecutive group of eight patients who underwent laparoscopic colectomy with a ‘fast track’ care plan that included TEA. However, Neudecker et al. were unable to confirm an advantage for TEA in an underpowered study of 20 patients who underwent laparoscopic colectomy. In the present study, which was arbitrarily powered to identify a difference of at least 1 day, TEA failed to reduce the duration of hospital stay significantly, but both groups had a very short mean stay of just over 2 days. Because the hospital stay was so short and the patients experienced virtually no postoperative ileus, no further improvement might be discernible even with TEA. Similarly, no differences were found in tolerance of diet or return of bowel function, which were the primary criteria for discharge. This reflects the authors’ ongoing interest in implementing perioperative care plans in open as well as laparoscopic colectomy. These studies have been accepted by both physicians and nursing staff, and have dramatically altered the implementation of postoperative rehabilitation strategies for all the authors’ patients due to the Hawthorne effect.

Although the study did not identify a difference in length of hospital stay, which was the primary outcome measure, pain control was significantly improved at 6 and 18 h with the use of TEA. It is unlikely that a narcotic-free approach to TEA would have altered the outcome owing to the rapid resolution of ileus and short hospital stay in both groups of patients. There was also a trend towards better analgesia at 24 h in the TEA group even though patients in both groups were switched to an oral narcotic analgesia regimen at 18 h. The present data support the continued use of TEA following laparoscopic colectomy as a means of further improving postoperative analgesia even with a minimally invasive surgical approach.

**References**


