Systematic review

Meta-analysis of epidural analgesia versus parenteral opioid analgesia after colorectal surgery

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Background: Epidural analgesia (EA) with local anaesthetic is considered to play a key role after colorectal surgery. However, its effect on postoperative recovery is still a matter of debate.

Methods: A systematic review of randomized controlled trials comparing postoperative EA and parenteral opioid analgesia after colorectal surgery was performed. The effect on postoperative recovery was evaluated in terms of length of hospital stay, pain intensity, duration of postoperative ileus, incidence of postoperative complications and side-effects.

Results: Sixteen trials published between 1987 and 2005 were included. EA significantly reduced pain scores and duration of ileus (weighted mean difference $-1.55$ (95 per cent confidence interval (c.i.) $-2.27$ to $-0.84$) days). On the other hand, it was associated with a significant increase in the incidence of pruritus (odds ratio (OR) $4.8$ (95 per cent c.i. $1.3$ to $17.0$)), urinary retention (OR $4.3$ (1.2 to $15.9$)) and arterial hypotension (OR $13.5$ (4.0 to $57.7$)). EA did not influence duration of hospital stay.

Conclusion: Despite improved analgesia and a decrease in ileus, EA has some adverse effects and does not shorten the duration of hospital stay after colorectal surgery.

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Introduction

Colorectal operations are among the most frequently performed major abdominal surgical procedures. Postoperative pain requiring bed rest and persistent gastrointestinal dysfunction are key factors keeping the patient in hospital. Although systemic opioids are effective for pain, they delay recovery of colonic mobility and prolong postoperative ileus. For more than 20 years epidural analgesia (EA) has been advocated as improving pain control, and it has been demonstrated to decrease the duration of ileus and postoperative complications in some studies. EA is currently considered as playing a key role in postoperative management after colorectal surgery, but studies have failed to demonstrate that it reduces hospital stay, and it may even increase the cost of postoperative pain management and be responsible for rare but devastating complications, such as epidural haematoma and abscess. In the light of the above, a systematic review of the literature was performed to assess the effect of EA with local anaesthetic (LA) on recovery, evaluated in terms of length of hospital stay, pain intensity, duration of ileus, incidence of complications and side-effects.

Methods

This study was conducted according to Quality of Reporting of Meta-analyses (QUOROM) recommendations for improving quality of meta-analysis.

Literature review and identification of studies

Three electronic databases were scrutinized through the internet for studies published between January 1966 and February 2006: PubMed (Medline/Index Medicus), the Cochrane Controlled Trials Register published by the Cochrane Library, and Embase. The medical subject heading (MeSH) terms used for the search were ‘colectomy’, ‘colon’, ‘sigmoid’, ‘rectal surgery’, 'colectomy', 'colon', 'sigmoid', 'rectal surgery',...
'lower abdominal surgery', 'major abdominal surgery', 'epidural analgesia', 'spinal analgesia', 'rehabilitation'. Additional articles were retrieved through hyperlinks and by manually searching reference lists in original published articles, review articles and correspondence. There was no language restriction. Authors were contacted for additional information on methodology or results when required.

Quality assessment of studies

Each study was subjected to a quality assessment by two investigators (C.R. and E.M.), who were not blinded to the authors or results. Disagreements were resolved by discussion and, when necessary, by a third assessor (F.B.). Each article was scored using the Oxford Modified Scale, an eight-point scale that evaluates randomization, blindness and completeness of patient follow-up13. One point was given if the study was described as randomized, and an additional point if the randomization method was described and was appropriate (for example, computer-generated table of random numbers). One point was given if there was a concealment of the allocation. One point was assigned if the study was described as blinded to the patients; no point if patients were not blinded. Similarly, one point was assigned when the provider was blinded, no point if not; another point was given if the observer was blinded, no point if not. No point was given if the follow-up was not specified, whereas one point was given if the article specified the numbers and reasons for withdrawals and dropouts. Finally, one point was added if data were treated on an intention-to-treat basis. The highest possible score was 8.

Selection criteria

Criteria for selection were as follows: randomized controlled design; including adults (aged more than 18 years) who underwent colonic or rectal surgery; comparing EA with LA versus parenteral opioid analgesia (patient controlled, on demand or systematic) or parenteral non-opioid analgesia; using postoperative EA; and elective surgery.

Exclusion criteria were: scoring less than 1 on the eight-point scale; having no control group; including patients younger than 18 years; describing emergency surgery; studying only opioid analgesia whatever the route of administration (for example, epidural morphine versus intramuscular morphine); using single epidural administration or epidural infusion for less than 24 hours; and including data from colorectal operations that could not be analysed separately from those of other major abdominal procedures after questioning the authors. There was no language restriction.

Outcomes

The primary outcome was duration of stay in hospital. Secondary outcomes were: postoperative pain scores measured by visual analogue scale (VAS) at 24 and 48 h; time to recovery of bowel function evaluated by time of first flatus or first bowel movement; incidence of anastomotic leakage; incidence of morphine side-effects, such as postoperative nausea and vomiting, sedation, pruritus, urinary retention and respiratory depression; and incidence of cardiac and pulmonary complications. The incidence of side-effects of EA (hypotension and motor blockade) was also studied. When data were not reported in the articles, the authors were contacted.

Statistical analysis

When not reported in the article, an intention-to-treat analysis was performed on the original data. All analyses were carried out with Review Manager software version 4.2 (Cochrane Collaboration, Nordic Cochrane Centre, Copenhagen, Denmark). For dichotomous data, the odds ratio (and 95 per cent confidence interval (c.i.)) was calculated using a fixed-effects model. A random-effects model was used when heterogeneity was significant ($P < 0.100$) without obvious reason. For continuous data (length of hospital stay, VAS scores), weighted mean differences (WMDs) were calculated taking into account study size and standard deviation as reported in the individual trials. When mean(s.d.) values were not reported, they were estimated from the median, range and size of the samples or interquartile range. Data were summarized graphically in forest plots. A qualitative analysis using a L'Abbé plot was also performed for length of hospital stay. A funnel plot was constructed to evaluate publication and other biases14. The funnel plot of the natural logarithm of the relative length of stay (length of stay with EA/length of stay with parenteral opioids) against sample size was symmetrical and centred around a relative length of stay of zero, suggesting that there is no publication or other bias (Fig. 1). A subgroup analysis was carried out on the primary outcome to test robustness and seek the presence of clinical heterogeneity15. All tests were two sided, and $P < 0.050$ was considered statistically significant.
Fig. 1 Funnel plot of natural logarithm of relative length of hospital stay in epidural analgesia and parenteral opioid analgesia (control) groups versus precision (sample size)

Results

Identification of the trials

Sixty-six relevant articles were identified. Forty were excluded for the following reasons: eight were letters or literature reviews, five were retrospective studies, 14 were prospective studies but not controlled trials, and 13 were off topic (Fig. 2). Of 26 randomized controlled trials (RCTs), ten were excluded because patients having colorectal surgery could not be analysed separately from those undergoing other abdominal surgical procedures. Sixteen studies were finally selected that included only patients having colorectal surgery, 406 in the EA group and 400 in the parenteral opioid (control) group (Fig. 2)5,10,16–29.

Study design, patients, type of anaesthesia and surgery

All RCTs were published between 1987 and 2005. All patients were American Society of Anesthesiologists (ASA) grade I–III, except nine who were ASA IV in one study21. Open surgery was performed in 14 studies and laparoscopic procedures in two24,27 (Table 1). Median score on the Oxford Modified Scale was 2. In the EA group, balanced anaesthesia was provided combining general anaesthesia and EA with LA in all trials except two in which epidural LA administration was started at the end of the operation17,26. Postoperative epidural continuous infusion, combining LA and opioid, was used in all but three studies in which only LA was used17,18,24. Patients received EA after surgery for 24 h to 6 days with a median duration of 60 h (Table 1). Additional boluses were administered by patient-controlled EA in three trials23,28,29. In the control group, parenteral opioids were oxycodone, pentazocine, piritramide, pethidine, tramadol and morphine. Parenteral opioids were administered by intravenous patient-controlled analgesia (PCA) in ten trials.

Qualitative and quantitative analysis of hospital stay

In studies published after 2000 a rehabilitation programme was used systematically in addition to analgesia, in all but two trials16,25 (Table 1). In contrast, up to the end of 2000 only two papers described patients as receiving specific rehabilitation in addition to EA for improving postoperative recovery5,24. Postoperative recovery programmes for fast-track surgery were based on multimodal analgesia with non-steroidal anti-inflammatory drugs used systematically in both groups, systematic removal of the nasogastric tube just after surgery, active mobilization, active oral feeding and/or prophylaxis of postoperative nausea and vomiting (Table 1).

Duration of hospital stay was not statistically different in the EA and control groups in the 13 studies that measured this variable5,10,16,18–21,25,27–29. The systematic review did not show a significantly different WMD in the duration of hospital stay between the two groups (WMD 0.07 (95 per cent c.i. −0.40 to 0.54) days; P = 0.760) (Fig. 3). Perioperative EA was used in all studies. The L’Abbé plot for length of hospital stay indicates that the duration...
<table>
<thead>
<tr>
<th>Reference</th>
<th>Year</th>
<th>Quality assessment</th>
<th>No. of patients</th>
<th>Protocol</th>
<th>Type of surgery</th>
<th>EA</th>
<th>Control</th>
<th>Additional measures to improve recovery in both groups</th>
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<tr>
<td>26</td>
<td>1987</td>
<td>1</td>
<td>15 15</td>
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<td>16 14</td>
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<td>57 59</td>
<td>Thoracic epidural bupivacaine 0.25% for 72 h</td>
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<td>Piritramide (i.m.); NSAIDs only in control group</td>
<td>NA</td>
<td></td>
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<td>22</td>
<td>1993</td>
<td>4</td>
<td>34 26</td>
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<td>Morphine (s.c.)</td>
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</tr>
<tr>
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<td>1995</td>
<td>2</td>
<td>14 12</td>
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<td>Open</td>
<td>PCA morphine (i.v.)</td>
<td>NGT-R, AOF</td>
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<tr>
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<td>1999</td>
<td>1</td>
<td>25 25</td>
<td>Lumbar epidural bupivacaine 0.125% + morphine for 48 h</td>
<td>Open</td>
<td>Continuous i.v. morphine; NSAIDs only in control group</td>
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</tr>
<tr>
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<td>3</td>
<td>10 10</td>
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<td>Laparoscopic</td>
<td>PCA morphine (i.v.)</td>
<td>NGT-R, MA, P-PONV</td>
<td></td>
</tr>
<tr>
<td>23</td>
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<td>3</td>
<td>20 26</td>
<td>Thoracic epidural bupivacaine 0.125% + sufentanil for 48 h</td>
<td>Open</td>
<td>PCA morphine (i.v.)</td>
<td>NGT-R, MA, P-PONV</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2001</td>
<td>2</td>
<td>23 21</td>
<td>Thoracic epidural bupivacaine 0.1% + fentanyl for 89 h</td>
<td>Open</td>
<td>PCA morphine or pethidine (i.v.)</td>
<td>NGT-R, AOF</td>
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<tr>
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<td>2001</td>
<td>2</td>
<td>21 21</td>
<td>Thoracic epidural bupivacaine 0.1% + fentanyl for 96 h</td>
<td>Open</td>
<td>PCA morphine (i.v.)</td>
<td>MA, NGT-R, AOF, AM</td>
<td></td>
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<tr>
<td>19</td>
<td>2002</td>
<td>3</td>
<td>32 32</td>
<td>Thoracic epidural bupivacaine 0.1% + fentanyl for 96 h</td>
<td>Open</td>
<td>PCA morphine (i.v.)</td>
<td>MA, NGT-R, AOF, AM</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>2002</td>
<td>2</td>
<td>20 20</td>
<td>Thoracic epidural ropivacaine 0.2% + sufentanil for 72 h</td>
<td>Open</td>
<td>PCA morphine (i.v.); NSAIDs only in control group</td>
<td>MA, NGT-R, AOF, AM</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>2002</td>
<td>1</td>
<td>20 21</td>
<td>Thoracic epidural ropivacaine 0.2% + fentanyl until patient satisfied discharge criteria or maximum of 6 days</td>
<td>Open</td>
<td>PCA morphine (i.v.)</td>
<td>MA, NGT-R, AOF, AM</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>2003</td>
<td>3</td>
<td>18 20</td>
<td>Thoracic epidural bupivacaine 0.1% + fentanyl for 24 h</td>
<td>Laparoscopic</td>
<td>PCA morphine (i.v.)</td>
<td>MA, AOF, P-PONV</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>2003</td>
<td>2</td>
<td>50 50</td>
<td>Thoracic epidural bupivacaine 0.1% + fentanyl for 72 h</td>
<td>Open</td>
<td>Pethidine (i.m.)</td>
<td>MA, AOF, P-PONV</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>2005</td>
<td>4</td>
<td>31 28</td>
<td>Thoracic epidural bupivacaine 0.1% + fentanyl for 48 h</td>
<td>Open</td>
<td>PCA morphine (i.v.)</td>
<td>NGT-R, AM, MA, AOF</td>
<td></td>
</tr>
</tbody>
</table>

EA, epidural analgesia; i.m., intramuscular; s.c., subcutaneous; i.v., intravenous; NSAIDs, non-steroidal anti-inflammatory drugs; PCA, patient-controlled analgesia; NGT-R, systematic removal of nasogastric tube after surgery; AOF, active oral feeding; MA, multimodal analgesia; P-PONV, prophylaxis against postoperative nausea and vomiting; AM, active mobilization.
was reduced in the most recent RCTs that included a postoperative rehabilitation programme (Fig. 4). A sensitivity analysis with a subgroup analysis was performed to study the effect of EA in addition to a rehabilitation programme. Duration of hospital stay was not significantly different in the EA and parenteral opioid groups, with or without a rehabilitation programme (WMD 0.08 (–0.46 to 0.52) days (P = 0.72) and WMD 0.05 (–0.91 to 1.01) days (P = 0.92) respectively). Similarly, no benefit in terms of hospital stay were noted when patients in the EA group had a catheter placed at the thoracic level (WMD 0.07 (–0.41 to 0.55) days; P = 0.77), patients in the EA group received only a combination of LA plus opioid (WMD 0.15 (–0.34 to 0.64) days; P = 0.55), or patients in the control group had a PCA device (WMD 0.15 (–0.35 to 0.66) days; P = 0.56) or received morphine as parenteral opioid analgesia (WMD 0.00 (–0.49 to 0.48) days; P = 0.99).

Secondary outcomes

Pain relief was measured by VAS in 11 studies (Table 2). EA provided lower VAS scores than systemic opioid at 24 and 48 h, respectively 18 and 12 mm versus 33 and 27 mm. All but one trial documented EA as shortening the duration of ileus, on average by 36 h (Table 2). Morphine side-effects, such as pruritus and urinary retention, were significantly more common in patients who received EA (21 versus 5 per cent and 10 versus 1 per cent in EA and parenteral opioid groups).

Fig. 3 Length of hospital stay after colorectal surgery: comparison between epidural analgesia (EA) and parenteral opioid analgesia (control). *Values are mean(s.d.). Weighted mean differences (WMDs) are shown with 95 per cent confidence intervals.

Fig. 4 L’Abbé plot of randomized controlled trials with year of publication for length of hospital stay after colorectal surgery. *Values are mean(s.d.). Weighted mean differences (WMDs) are shown with 95 per cent confidence intervals.
and cardiopulmonary complications (2 versus anastomotic leakage (5 versus 11 trials (Table 2). No significant difference between EA and parenteral opioid groups was documented for 

<table>
<thead>
<tr>
<th>Reference</th>
<th>EA</th>
<th>Control</th>
<th>Effect size</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Pain at day 1 (VAS score)*</td>
<td>5, 18–23, 25–27, 29</td>
<td>317</td>
<td>313</td>
<td>WMD −15 (−19, −11)</td>
</tr>
<tr>
<td>Pain at day 2 (VAS score)*</td>
<td>5, 19–21, 28, 29</td>
<td>143</td>
<td>138</td>
<td>WMD −18 (−26, −10)</td>
</tr>
<tr>
<td>Duration of gastrointestinal dysfunction (days)</td>
<td>5, 10, 17, 18, 20–23, 26, 28, 29</td>
<td>255</td>
<td>255</td>
<td>WMD −1.55 (−2.27, −0.84)</td>
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<tr>
<td>Postoperative nausea and vomiting</td>
<td>16, 21, 24, 27, 28</td>
<td>93</td>
<td>96</td>
<td>OR 1.2 (0.6, 2.3)</td>
</tr>
<tr>
<td>Pruritus</td>
<td>16, 27, 28</td>
<td>58</td>
<td>61</td>
<td>OR 4.8 (1.3, 17.0)</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>10, 16, 19, 24, 27</td>
<td>103</td>
<td>102</td>
<td>OR 4.3 (1.2, 15.9)</td>
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<tr>
<td>Sedation</td>
<td>10, 16</td>
<td>43</td>
<td>41</td>
<td>OR 2.9 (0.11, 75.0)</td>
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<tr>
<td>Motor block</td>
<td>10, 23, 24</td>
<td>64</td>
<td>64</td>
<td>OR 4.3 (0.4, 42)</td>
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<tr>
<td>Hypotension</td>
<td>16, 23, 25–29</td>
<td>183</td>
<td>186</td>
<td>OR 13.5 (4.0, 57.7)</td>
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<tr>
<td>Anastomotic leakage</td>
<td>10, 17–19, 22, 23, 25</td>
<td>232</td>
<td>227</td>
<td>OR 1.2 (0.5, 2.7)</td>
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<tr>
<td>Cardiopulmonary complications</td>
<td>5, 10, 18–21, 23, 25, 27</td>
<td>271</td>
<td>272</td>
<td>OR 0.6 (0.2, 1.5)</td>
</tr>
</tbody>
</table>

Values in parentheses are 95 per cent confidence intervals. *Pain was measured on a visual analogue scale (VAS) from 0 to 100. An odds ratio (OR) less than 1 or a negative weighted mean difference (WMD) favours epidural analgesia (EA).

Major postoperative complications were reported in 11 trials (Table 2). No significant difference between EA and parenteral opioid groups was documented for anastomotic leakage (5 versus 4 per cent respectively) and cardiopulmonary complications (2 versus 4 per cent). Epidural side-effects were reported in seven studies (Table 2). Hypotension was significantly more frequent in the epidural group (10 versus 0 per cent). The incidence of motor block was not significantly different (5 versus 0 per cent).

**Discussion**

This systematic review has shown that EA does not shorten the duration of hospital stay after colorectal surgery, despite being associated with a significant decrease in VAS pain score and duration of ileus. Improved analgesia with EA compared with parenteral opioids has been demonstrated for 2 days after surgery in a recent meta-analysis, supporting the findings of the present review.

Another systematic review has also documented a reduction of postoperative ileus after major abdominal surgery. Postoperative ileus is one of the most significant side-effects and one of the limiting factors for early recovery after colonic surgery. Gastrointestinal dysfunction after abdominal surgery may have numerous causes, including autonomic nervous system dysfunction, inflammatory response, anaesthetic and opioid administration, and gastrointestinal hormone disruption. The mechanism of ileus shortening by EA may include a decrease in sympathetic tone, stress response and inflammatory processes. The benefits of reduction of ileus include patient comfort and facilitation of oral feeding. Other strategies, however, such as administration of gastrointestinal opioid receptor antagonists or multimodal analgesia using anti-inflammatory drugs, have also been demonstrated to speed recovery of bowel function after abdominal surgery.

Moreover, an epidural catheter may be associated with inadequate analgesia or technical failure. In a large RCT comparing epidural with systemic analgesia, almost 40 per cent of the patients assigned to EA had the catheter removed prematurely. Indeed, Zutshi and colleagues have recently questioned the benefit of using EA after colorectal surgery when patients receive fast-track postoperative care. Anastomotic leakage is the most important surgical complication after colonic procedures; it may increase morbidity, duration of hospital stay and mortality. The frequency of detectable leakage varies from 6 to 15 per cent in the studied literature. The stimulatory effect of EA on gastrointestinal mobility may lead to some theoretical concern about increasing anastomotic leakage but, on the other hand, segmental autonomic blockade may increase the blood supply to the anastomosis and improve healing. In the present meta-analysis, the anastomotic leak rate was much the same whatever the analgesic technique. Shortening the delay to recovery of bowel function has no drawback in terms of anastomotic leakage, contrary to previous suggestions.

EA may facilitate physiotherapy and ambulation. Moreover, it attenuates the hormonal and metabolic stress response to surgery and improves homeostasis. Taken together with the shortening of ileus, these benefits might be expected to lead to a reduction in...
postoperative morbidity and hospital stay. Despite better pain control, however, two large RCTs have failed to demonstrate any benefit in terms of mortality, morbidity and duration of hospital stay with EA.\(^6\) Still, these studies did not employ specific perioperative care to accelerate postoperative recovery, such as early mobilization and oral feeding, and avoiding routine postoperative nasogastric decompression and mechanical bowel preparation\(^{10,37}\). Significant improvements in postoperative recovery and reduced hospital stay have, indeed, been demonstrated thanks to multimodal rehabilitation programmes\(^{38}\). In the present review, the L’Abbé plot of duration of hospital stay according to the analgesic technique shows that the most recently published trials document a shorter length of hospital stay; its mean duration had decreased from over 2 weeks to less than 1 week in the most recent reports.

One might argue that discharge criteria may have been set several hours or days before the discharge event, and that duration of hospital stay depends on factors other than medical ones. Indeed Liu and co-workers\(^5\) have reported a difference in postoperative ileus and discharge criteria in patients having colonic surgery with EA compared with those receiving intravenous PCA morphine, but they failed to find any difference in hospital stay. Nevertheless, as noted above, the duration of stay has decreased in recent years while the lack of difference between EA and parenteral analgesia groups has persisted.

More important than year of publication is whether a rehabilitation programme was or was not used. A multimodal approach is considered to limit the undesirable consequences of surgery, to reduce morbidity and so improve the postoperative period\(^{39}\). This strategy is based on multimodal analgesia, active oral renutrition after surgery, minimally invasive surgery and adequate pain relief. Such an approach has been shown both to reduce hospital stay and to enhance recovery after colonic surgery\(^6\). Not surprisingly, the most recently published studies included in the present review used a multimodal approach in addition to EA or systemic opioid analgesia\(^{5,10,19–20,27–29}\). Interestingly, these studies have shown that hospital stay after colorectal surgery is now less than 10 days (Fig. 4). The present review suggests that it is the multimodal programme rather than the analgesic technique that improves recovery.

Combination of trials that differ in terms of underlying condition, operation and intervention in a meta-analysis is inappropriate, and so only patients having colorectal surgery were included in the present work. The aim was to increase clinical homogeneity between trials. Rehabilitation programmes in addition to EA have been used in some trials and not in others but it is noteworthy that the lack of effect of EA on length of hospital stay is homogeneous across a set of trials that were clearly heterogeneous in terms of postoperative management. Another limitation of the meta-analysis is the poor methodological quality of the studies and the small number of patients included\(^{40,41}\). The method of randomization was often not described in sufficient detail and blinding assessment of outcomes was not performed, probably because of ethical concern about the placement of sham epidural catheters. Finally, the absence of double-blinding might theoretically have overvalued the effect of EA on some measures of postoperative recovery\(^{41}\). However, others have suggested that individual quality measures, such as blinding, are not reliably associated with the strength of treatment effect in a meta-analysis of RCTs\(^{42}\).

Another limitation is that duration of hospital stay was not pre-established according to specific discharge criteria. In fact, duration of stay was evaluated as a secondary endpoint in most of the studies included in the present work and may depend on many components, such as departmental organization, healthcare system and professional habits. A multimodal recovery programme after colonic surgery with pre-established endpoints reduces the hospital stay\(^4\). The gap between readiness for discharge and length of hospital stay represents real life, where discharge may be difficult despite better analgesia and shorter postoperative ileus\(^{43}\). EA alone is not sufficient to shorten hospital stay after elective colorectal surgery, although it should be included in fast-track programmes within a structured surgical departmental organization\(^{18,43}\).

In conclusion, the present review supports the beneficial effect of EA on pain control and gastrointestinal dysfunction after colorectal surgery. These advantages, however, do not shorten hospital stay. Rather than focusing on specific analgesic techniques, future studies on postoperative care and duration of hospital stay should adopt a global approach to patient management.

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References


