



## Colonic Resection 2009

### Summary Recommendations

#### Notes on PROSPECT recommendations

Recommendations are graded according to the overall level of evidence (LoE) on which the recommendations are based, which is determined by the quality and source of evidence:

[Appendix A: Levels of evidence and grades of recommendation.](#)

PROSPECT provides clinicians with supporting arguments for and against the use of various interventions in postoperative pain based on published evidence and expert opinion. Clinicians must make judgements based upon the clinical circumstances and local regulations. At all times, local prescribing information for the drugs referred to must be consulted.

**Results from the open and laparoscopic colonic resection studies are dealt with separately, because of the different pain profiles associated with these approaches.**

## Summary recommendations: Open Colonic Resection

Pre-, intra- and postoperative interventions have been evaluated for the management of postoperative pain following colonic resection. Unless otherwise stated, 'pre-operative' refers to interventions applied before surgical incision, 'intra-operative' refers to interventions applied after incision and before wound closure, 'postoperative' refers to interventions applied at or after wound closure.

The following pre-, intra- and postoperative interventions have been evaluated, for the management of postoperative pain following open colonic resection:

### ***Pre-operative***

#### ***Recommended:***

##### *Systemic analgesia*

- COX-2-selective inhibitors (Grade B) (only for patients who do not receive epidural analgesia)
- Continuous administration of pre-/intra-operative IV lidocaine if continued during the immediate postoperative period (Grade B), when epidural analgesia is not feasible or contra-indicated

##### *Epidural analgesia*

- Continuous thoracic epidural anaesthesia and analgesia, at a level appropriate to the site of incision are recommended for routine use (Grade A)
- A combination of strong opioid and local anaesthetic is recommended (Grade A) because of the increased analgesic efficacy of the combination compared with strong opioids alone

### ***Pre-operative***

#### ***Not recommended:***

##### *Systemic analgesia*

- IV clonidine (Grade D) because it is associated with an increased risk of hypotension and bradycardia
- Conventional NSAIDs (Grade B) because pre-operative administration of these agents can increase the risk of intra- and postoperative bleeding
- Corticosteroids for analgesia (Grade A) because of procedure-specific evidence showing no significant benefit in reducing pain scores (but they may be used for reduction of PONV)
- Gabapentin/pregabalin (Grade D) due to a lack of procedure-specific evidence
- Continuous administration of IV lidocaine limited to the pre-/intra-operative period (Grade D), because of inconsistent and insufficient procedure-specific evidence
- NMDA receptor antagonists (Grade D) because of limited procedure-specific evidence

- Strong opioids (Grade B) as they are significantly less effective than postoperative strong opioids for reducing postoperative pain
- Weak opioids (Grade B) based on procedure-specific evidence that they provide limited postoperative analgesic benefit compared with postoperative administration
- *Calcium channel antagonists (Grade B) based on limited procedure-specific evidence showing a lack of postoperative analgesic effect*

#### *Spinal anaesthesia*

- Spinal morphine (Grade D) because of the risk of side effects
- Spinal clonidine (Grade B) based on procedure-specific evidence showing limited analgesic effect and the risk of side effects

#### *Non-pharmacological therapy*

- Pre-operative use of guided imagery (Grade D) because of limited procedure-specific evidence
- Laxatives for analgesia (Grade B) because limited procedure-specific evidence shows no analgesic benefit (but they may be used for reasons other than pain relief)
- Pentoxifylline (Grade D) due to limited procedure-specific evidence of its analgesic effect

#### *LA for analgesia*

- Bilateral TAP block (Grade D) because of limited procedure-specific evidence

### ***Intra-operative***

#### ***Recommended:***

#### *Systemic analgesia*

- COX-2-selective inhibitors (Grade B) (only for patients who do not receive epidural anaesthesia)
- Strong opioids (Grade B) (only for patients who do not receive epidural anaesthesia)
- Continuous administration of pre-/intra-operative IV lidocaine if continued during the immediate postoperative period, when epidural analgesia is not feasible or contra-indicated (Grade B)

#### *Epidural analgesia*

- Continuous thoracic epidural anaesthesia and analgesia, at a level appropriate to the site of incision are recommended for routine use (Grade A)
- Combination of strong opioid and local anaesthetic is recommended (Grade A) based on procedure-specific evidence of their combined efficacy, in reducing postoperative pain and opioid use, compared with LA alone

### *Operative techniques*

- The decision concerning the type of operative technique or incision to use for colonic resection should be primarily based on factors other than the management of postoperative pain, e.g. malignancy *versus* benign disease operative risk factors of the patient, risk of wound infection, and availability of surgical expertise (Grade D)
- Laparoscopic colonic resection is recommended over open colon surgery for reducing postoperative pain, if the conditions outlined above allow (Grade A)
- Horizontal/curved (transverse) incision is recommended over a vertical incision for analgesic and other benefits if the operative conditions allow (Grade B). In addition, the horizontal/curved incision is preferred for its cosmetic benefits (Grade D)
- Diathermy is recommended over the scalpel (Grade B)
- Maintenance of normothermia is recommended for improved clinical outcomes, but it is not helpful for reducing postoperative pain (Grade A)

### ***Intra-operative***

#### ***Not recommended:***

#### *Systemic analgesia*

- IV clonidine (Grade D) because it associated with an increased risk of hypotension, sedation and bradycardia
- *Calcium channel antagonists (Grade B), based on limited procedure-specific evidence showing a lack of postoperative analgesic effect*
- Gabapentin/pregabalin (Grade D) due to a lack of procedure-specific evidence
- Continuous administration of IV lidocaine limited to the pre-/intra-operative period (Grade D) because of inconsistent and insufficient procedure-specific evidence
- NMDA receptor antagonists (Grade D) because of limited procedure-specific evidence of analgesic efficacy
- Strong opioids (Grade D) in patients receiving epidural analgesia
- Weak opioids (Grade D) because placebo-controlled evidence for their benefit in reducing postoperative pain is limited. In patients not receiving epidural analgesia, strong opioids, not weak opioids, are recommended

#### *Epidural analgesia*

- Addition of clonidine to the combination of epidural LA + opioid (Grade D) because of side effects

#### *Spinal analgesia*

- Spinal analgesia in combination with epidural anaesthesia (Grade B) based on a lack of benefit in reducing postoperative pain in colonic resection

## **Postoperative**

### **Recommended:**

#### *Systemic analgesia*

- COX-2-selective inhibitors (Grade B) (only for patients who do not receive epidural analgesia or with the cessation of epidural analgesia)
- Conventional NSAIDs (Grade A) (only for patients who do not receive epidural analgesia or with cessation of epidural analgesia)
- IV lidocaine (Grade B) (when epidural is not feasible or contra-indicated)
- Strong opioids (Grade B) (for high-intensity pain)
- Weak opioids (Grade B) in association with other non-opioid analgesics (for moderate- or low-intensity pain), or if non-opioid analgesia is insufficient or contra-indicated
- Paracetamol (Grade B) for moderate- or low-intensity pain (only for patients that do not receive epidural analgesia, or after cessation of epidural analgesia)

#### *Epidural analgesia*

- Continuous thoracic epidural anaesthesia and analgesia at a level appropriate to the site of incision(Grade A)
- A combination of strong opioid and local anaesthetic is recommended for epidural analgesia (Grade A)

#### *Wound infiltration or infusion*

- Continuous pre-peritoneal infusion of LA, as an alternative when epidural analgesia is not feasible or contra-indicated (Grade B)

#### *Multi-modal rehabilitation protocols*

- Care protocols (which include controlled rehabilitation with early ambulation and diet, or multi-modal optimisation programmes) (Grade A)

## **Postoperative**

### **Not recommended:**

#### *Systemic analgesia*

- Gabapentin/pregabalin (Grade D) due to a lack of procedure-specific evidence
- NMDA receptor antagonists (Grade D) because of limited procedure-specific evidence of analgesic efficacy
- IM strong opioids (Grade D)
- Weak opioids (for controlling high-intensity pain) (Grade B)

### *Wound infiltration or infusion*

- Continuous postoperative wound infusion with LA (Grade D) as procedure-specific evidence is limited and inconsistent
- Pre-closure wound infiltration with local anaesthetic (Grade D) due to lack of procedure-specific evidence and inconclusive transferable evidence from other large abdominal surgeries

### *Multi-modal rehabilitation protocols*

- Mechanical massage with aspiration of abdominal wall (Grade D) as further supportive data are needed
- Nasogastric tubes (Grade B) because they are associated with discomfort and inconvenience and do not decrease the duration of postoperative ileus

## Summary recommendations: Laparoscopic Colonic Resection

### **Recommended:**

#### *Systemic analgesia*

- Conventional NSAIDs (Grade B) based on limited procedure-specific evidence

#### *Epidural analgesia*

- Epidural analgesia is recommended in high-risk pulmonary patients (Grade D)

#### *Wound infiltration/infusion*

- Pre-closure wound infiltration with LA (Grade B)

#### *Operative techniques*

- The decision concerning the type of operative technique or incision to use for colonic resection should be primarily based on factors other than the management of postoperative pain, e.g. malignancy versus benign disease; operative risk factors of the patient; risk of wound infection; and availability of surgical expertise (Grade D)
- Laparoscopic colonic resection is recommended over open colon surgery for reducing postoperative pain, if the conditions outlined above allow (Grade A)

### **Not recommended:**

#### *Systemic analgesia*

- Continuous intra-/postoperative IV lidocaine (Grade D) because of limited procedure-specific data, despite some positive transferable evidence

#### *Spinal analgesia*

- Combination of spinal analgesia and general anaesthesia (Grade D) as the risk: benefit balance is not positive, and because of limited procedure-specific evidence

#### *Epidural analgesia*

- Epidural LA + strong opioid (Grade D) due to poor risk:benefit ratio

#### *Gasless laparoscopic colectomy*

- Gasless laparoscopy (Grade B) based on procedure-specific evidence showing lack of analgesic effect

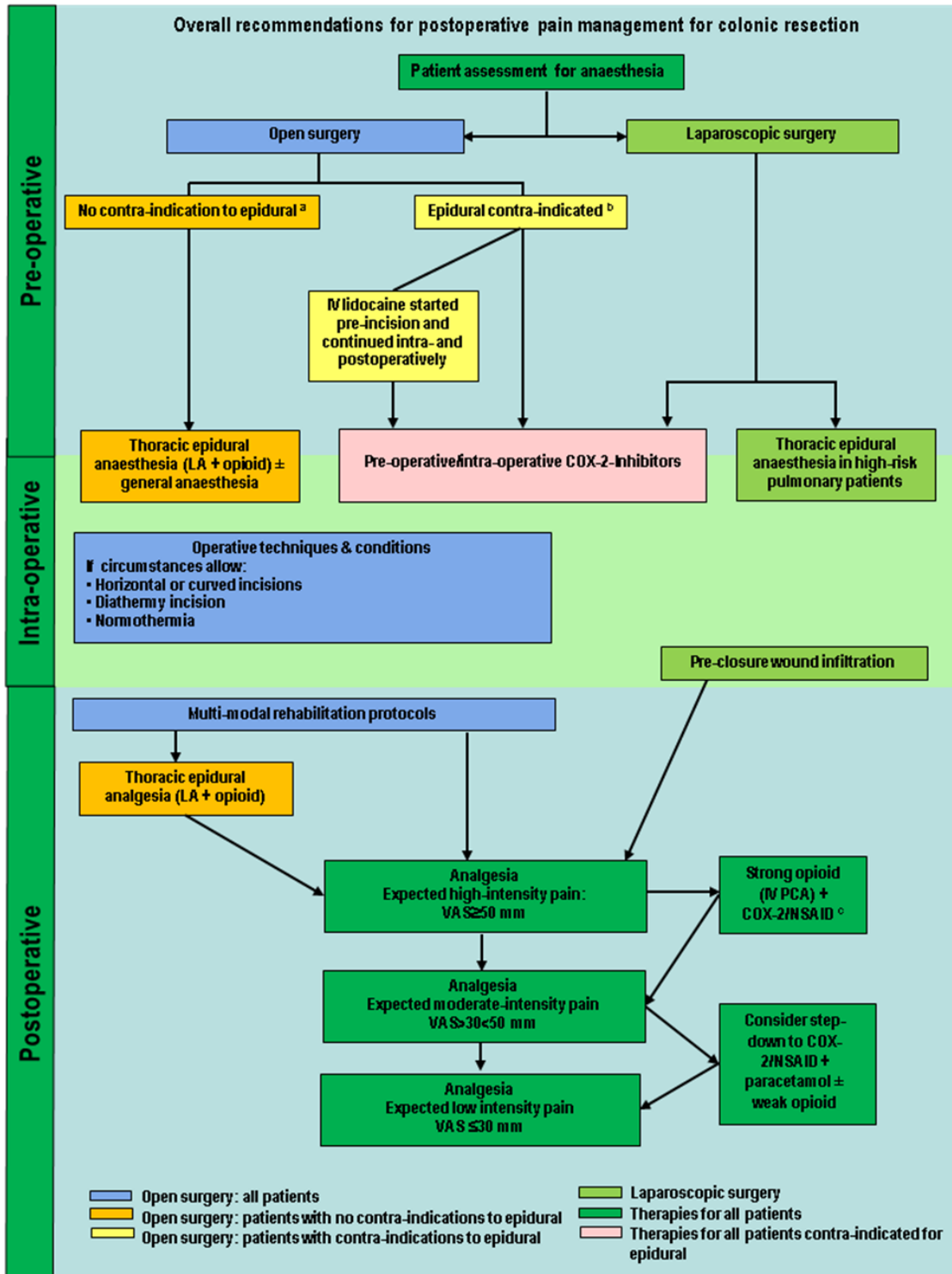
#### *Laxatives*

- Laxatives for analgesia (Grade B) because limited procedure-specific evidence shows no analgesic benefit (but they may be used for reasons other than pain relief)

#### *Multi-modal rehabilitation protocols*

- Postoperative restriction of IV fluids (Grade B) due to procedure-specific evidence showing limited analgesic efficacy

# Overall Recommendations: Pain Management for Colonic Resection



## Evidence review process

For each review, a Subgroup of the prospect Working Group performs an initial evaluation of the evidence and also drafts clinical practice statements and recommendations, which are then discussed by the whole Working Group before a final consensus is reached. The Subgroup may sometimes include a non-Working Group member, to provide additional expertise in the procedure being reviewed.

For the colonic resection surgery review (update 2009), the Subgroup members were:

- Professor Francis Bonnet (PROSPECT Working Group member)
- Professor Frederic Camu (PROSPECT Working Group member)

### Details of systematic literature review

#### *Literature search*

- Systematic review of the literature from 1966–March 2009 using MEDLINE and EmBASE, following the protocol of the Cochrane Collaboration
- Inclusion of randomised studies assessing analgesic interventions in colonic resection and reporting pain on a linear analogue scale ([Appendix B: Colonic Resection: Search terms](#))
- Identification of studies of peri-operative interventions for postoperative pain following colonic resection
  - 80 studies included ([Appendix C: Colonic Resection: Included studies](#))
  - 73 studies excluded ([Appendix D: Colonic Resection: Excluded references](#))
- The most common reasons for exclusion were the lack of VAS postoperative pain scores (32 studies), and the lack of a defined subgroup of patients undergoing colonic resection (16 studies) ([Appendix E: Colonic Resection: Reasons for exclusion](#))
- A majority of the studies assessed the effect of analgesic interventions in open colonic resection with the exception of:
  - Nine studies in laparoscopic colonic surgery (Kaba 2007, Kong 2002, Marcello 2008, Neudecker 1999, Schlachta 2003, Schulze 1999, Senagore 2003, Taqi 2007, Targarona 2002)
  - Ten studies comparing laparoscopic colonic surgery with open colonic surgery (Basse 2005, Chung 2007, Danelli 2002, Kang 2004, Leung 2004, Liang 2002, Maartense 2004, Schwenk 2000, Stage 1997, Weeks 2002)

# Appendix

## A. Levels of evidence and grades of recommendation

Study type	Study quality assessments					Level of Evidence (LoE)	Grade of recommendation (based on overall LoE, considering balance of clinical practice information and evidence)	
	Statistical analyses and patient follow-up assessment		Allocation concealment	Jadad scores	Additional assessment of overall study quality required to judge LoE		Procedure-specific	Transferable
Systematic review with homogeneous results	N/A		N/A	N/A	N/A	1	A	B
Randomised controlled trial (RCT)	Statistics reported and >80% follow-up	AND	A	(1-5)	N/A	1	A (based on two or more studies or a single large, well-designed study)	B
			OR					
			B	(3-5)	N/A			
			OR					
RCT	Statistics not reported or questionable or <80% follow-up	AND/OR	B	(1-2)	Yes	2	B (or extrapolation from one procedure-specific LoE 1 study)	C
			OR					
			C	(1-5)	N/A			
			OR					
Non-systematic review, cohort study, case study; (e.g. some adverse effects evidence)	N/A		N/A			3	C	
			N/A					
Clinical practice information (expert opinion); inconsistent evidence	N/A		N/A			4	D	

## B. Colonic Resection: Search terms

### Summary of index search terms for Colonic Resection Update (February 2004–March 2009)

Colon resection  
 Colectomy  
 Colorectal surgery  
 Colonic surgery  
 Colectomy  
 Colorectal surgery  
 Pain  
 Analgesia  
 Anesthetics  
 Anesthetic  
 Postoperative pain

Search limits:

Randomized controlled study or trial

Randomised controlled study or trial

Clinical study or trial

Language=English

Human or humans

### C. Colonic Resection: Included studies

Akca O, Lenhardt R, Fleischmann E, Treschan T, Greif R, Fleischhackl R, Kimberger O, Kurz A, Sessler DI. Nitrous oxide increases the incidence of bowel distension in patients undergoing elective colon resection. *Acta Anaesthesiol Scand* 2004;48(7): 894–898.

Anderson AD, McNaught CE, MacFie J, Tring I, Barker P, Mitchell CJ. Randomized clinical trial of multimodal optimization and standard perioperative surgical care. *Br J Surg* 2003;90(12):1497–1504.

Basse L, Jakobsen DH, Bardram L, Billesbolle P, Lund C, Mogensen T, Rosenberg J, Kehlet H. Functional recovery after open versus laparoscopic colonic resection: a randomized, blinded study. *Ann Surg* 2005;241(3): 416–423.

Beaussier M, El'Ayoubi H, Schiffer E, Rollin M, Parc Y, Mazoit JX, Azizi L, Gervaz P, Rohr S, Biermann C, Lienhart A, Eledjam JJ. Continuous preperitoneal infusion of ropivacaine provides effective analgesia and accelerates recovery after colorectal surgery: a randomized, double-blind, placebo-controlled study. *Anesthesiology* 2007;107(3): 461–468.

Beaussier M, Weickmans H, Parc Y, Delpierre E, Camus Y, Funck-Brentano C, Schiffer E, Delva E, Lienhart A. Postoperative analgesia and recovery course after major colorectal surgery in elderly patients: a randomized comparison between intrathecal morphine and intravenous PCA morphine. *Reg Anesth Pain Med* 2006;31(6): 531–538.

Bonnet F, Blery C, Zatan M, Simonet O, Brage D, Gaudy J. Effect of epidural morphine on post-operative pulmonary dysfunction. *Acta Anaesthesiol Scand* 1984;28(2):147–151.

Bredtmann RD, Herden HN, Teichmann W, Moecke HP, Kniesel B, Baetgen R, Tecklenburg A. Epidural analgesia in colonic surgery: results of a randomized prospective study. *Br J Surg* 1990;77(6):638–642.

Carli F, Trudel JL, Belliveau P. The effect of intraoperative thoracic epidural anesthesia and postoperative analgesia on bowel function after colorectal surgery: a prospective, randomized trial. *Dis Colon Rectum* 2001;44(8):1083–1089.

Carli F, Mayo N, Klubien K, Schrickler T, Trudel J, Belliveau P. Epidural analgesia enhances functional exercise capacity and health-related quality of life after colonic surgery: results of a randomized trial. *Anesthesiology* 2002;97(3):540–549.

Cataldo PA, Senagore AJ, Kilbride MJ. Ketorolac and patient controlled analgesia in the treatment of postoperative pain. *Surg Gynecol Obstet* 1993;176(5):435–438.

Chen JY, Wu GJ, Mok MS, Chou YH, Sun WZ, Chen PL, Chan WS, Yien HW, Wen YR. Effect of adding ketorolac to intravenous morphine patient-controlled analgesia on bowel function in colorectal surgery patients—a prospective, randomized, double-blind study. *Acta Anaesthesiol Scand* 2005;49(4):546–551.

Cheong WK, Seow-Choen F, Eu KW, Tang CL, Heah SM. Randomized clinical trial of local bupivacaine perfusion versus parenteral morphine infusion for pain relief after laparotomy. *Br J Surg* 2001;88(3):357–359.

Chung CC, Ng DC, Tsang WW, Tang WL, Yau KK, Cheung HY, Wong JC, Li MK. Hand-assisted laparoscopic versus open right colectomy: a randomized controlled trial. *Ann Surg* 2007;246(5): 728–733.

Culebras X, Savoldelli GL, Van Gessel E, Klopfenstein CE, Saudan-Frei S, Schiffer E. Low-dose sufentanil does not potentiate intrathecal morphine for perioperative analgesia after major colorectal surgery. *Can J Anaesth* 2007;54(10): 811–817.

Dahl JB, Hansen BL, Hjortso NC, Erichsen CJ, Moiniche S, Kehlet H. Influence of timing on the effect of continuous extradural analgesia with bupivacaine and morphine after major abdominal surgery. *Br J Anaesth* 1992;69(1):4–8.

Danelli G, Berti M, Perotti V, Albertin A, Baccari P, Deni F, Fanelli G, Casati A. Temperature control and recovery of bowel function after laparoscopic or laparotomic colorectal surgery in patients receiving combined epidural/general anesthesia and postoperative epidural analgesia. *Anesth Analg* 2002;95(2):467–471.

De Kock M, Lavandhomme P, Scholtes JL. Intraoperative and postoperative analgesia using intravenous opioid, clonidine and Lidocaine. *Anaesth Intensive Care* 1994;22(1):15–21.

De Kock M, Lavand'homme P, Waterloos H. The short-lasting analgesia and long-term antihyperalgesic effect of intrathecal clonidine in patients undergoing colonic surgery. *Anesth Analg* 2005;101(2): 566–572.

Delaney CP, Zutshi M, Senagore AJ, Remzi FH, Hammel J, Fazio VW. Prospective, randomized, controlled trial between a pathway of controlled rehabilitation with early ambulation and diet and traditional postoperative care after laparotomy and intestinal resection. *Dis Colon Rectum* 2003;46(7):851–859.

Delaunay L, Leppert C, Dechaubry V, Levron JC, Liu N, Bonnet F. Epidural clonidine decreases postoperative requirements for epidural fentanyl. *Reg Anesth* 1993;18(3):176–180.

Derrode N, Lebrun F, Levron JC, Chauvin M, Debaene B. Influence of peroperative opioid on postoperative pain after major abdominal surgery: sufentanil TCI versus remifentanil TCI. A randomized, controlled study. *Br J Anaesth* 2003;91(6):842–849.

Finucane BT, Sandler AN, McKenna J, Reid D, Milner AL, Friedlander M, Muzyka D, O'Callaghan-Enright S, Chan V. A double-blind comparison of ropivacaine 0.5%, 0.75%, 1.0% and bupivacaine 0.5%, injected epidurally, in patients undergoing abdominal hysterectomy. *Can J Anaesth* 1995;43(5 Pt 1):442–449.

Finucane BT, Ganapathy S, Carli F, Pridham JN, Ong BY, Shukla RC, Kristoffersson AH, Huizar KM, Nevin K, Ahlen KG. Prolonged epidural infusions of ropivacaine (2 mg/mL) after colonic surgery: the impact of adding fentanyl. *Anesth Analg* 2001;92(5):1276–1285.

Fleischmann E, Lenhardt R, Kurz A, Herbst F, Fulesdi B, Greif R, Sessler DI, Akca O. Nitrous oxide and risk of surgical wound infection: a randomised trial. *Lancet* 2005;366(9491): 1101–1107.

Guignard B, Bossard AE, Coste C, Sessler DI, Lebrault C, Alfonsi P, Fletcher D, Chauvin M. Acute opioid tolerance: intraoperative remifentanil increases postoperative pain and morphine requirement. *Anesthesiology* 2000;93(2):409–417.

Guignard B, Coste C, Costes H, Sessler DI, Lebrault C, Morris W, Simonnet G, Chauvin M. Supplementing desflurane-remifentanil anesthesia with small-dose ketamine reduces perioperative opioid analgesic requirements. *Anesth Analg* 2002;95(1):103–108.

Haase O, Schwenk W, Hermann C, Muller JM. Guided imagery and relaxation in conventional colorectal resections: a randomized, controlled, partially blinded trial. *Dis Colon Rectum* 2005;48(10):1955–1963.

Herroeder S, Pecher S, Schonherr ME, Kaulitz G, Hahnenkamp K, Friess H, Bottiger BW, Bauer H, Dijkgraaf MG, Durieux ME, Hollmann MW. Systemic lidocaine shortens length of hospital stay after colorectal surgery: a double-blinded, randomized, placebo-controlled trial. *Ann Surg* 2007;246(2):192–200.

Hoffmann S, Koller M, Plaul U, Stinner B, Gerdes B, Lorenz W, Rothmund M. Nasogastric tube versus gastrostomy tube for gastric decompression in abdominal surgery: a prospective, randomized trial comparing patients' tube-related inconvenience. *Langenbecks Arch Surg* 2001;386(6):402–409.

Kaba A, Laurent SR, Detroz BJ, Sessler DI, Durieux ME, Lamy ML, Joris JL. Intravenous lidocaine infusion facilitates acute rehabilitation after laparoscopic colectomy. *Anesthesiology* 2007;106(1): 11-18.

Kilbride MJ, Senagore AJ, Mazier WP, Ferguson C, Ufkes T. Epidural analgesia. *Surg Gynecol Obstet* 1992;174(2):137–140. Kirdak Tea. Does single, low-dose preoperative dexamethasone improve outcomes after colorectal surgery based on an enhanced recovery protocol? Double-blind, randomized clinical trial *American Surgeon* 2008;74/2 160–167.

Kong SK, Onsieng SM, Chiu WK, Li MK. Use of intrathecal morphine for postoperative pain relief after elective laparoscopic colorectal surgery. *Anaesthesia* 2002;57(12): 1168–1173.

Koo M, Sabate A, Dalmau A, Camprubi I. Sevoflurane requirements during coloproctologic surgery: difference between two different epidural regimens. *J Clin Anesth* 2003;15(2):97–102.

Kurz A, Sessler DI, Narzt E, Bekar A, Lenhardt R, Huemer G, Lackner F. Postoperative hemodynamic and thermoregulatory consequences of intraoperative core hypothermia. *J Clin Anesth* 1995;7(5):359–366.

Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Engl J Med* 1996;334(19):1209–1215.

Lavand'homme P, De Kock M, Waterloos H. Intraoperative epidural analgesia combined with ketamine provides effective preventive analgesia in patients undergoing major digestive surgery. *Anesthesiology* 2005;103(4): 813–820.

Le Blanc-Louvry I, Costaglioli B, Boulon C, Leroi AM, Ducrotte P. Does mechanical massage of the abdominal wall after colectomy reduce postoperative pain and shorten the duration of ileus? Results of a randomized study. *J Gastrointest Surg* 2002;6(1):43–49.

Lee LH, Irwin MG, Yao TJ, Yuen MK, Cheung CW. Timing of intraoperative parecoxib analgesia in colorectal surgery *Acute Pain* 2008;10(3-4): 123–130.

Lee LH, Irwin MG, Lui SK. Intraoperative remifentanyl infusion does not increase postoperative opioid consumption compared with 70% nitrous oxide. *Anesthesiology* 2005;102(2): 398–402.

Lu CH, Chao PC, Borel CO, Yang CP, Yeh CC, Wong CS, Wu CT. Preincisional intravenous pentoxifylline attenuating perioperative cytokine response, reducing morphine consumption, and improving recovery of bowel function in patients undergoing colorectal cancer surgery. *Anesth Analg* 2004;99(5): 1465–1471.

Leung KL, Kwok SP, Lam SC, Lee JF, Yiu RY, Ng SS, Lai PB, Lau WY. Laparoscopic resection of rectosigmoid carcinoma: prospective randomised trial. *Lancet* 2004;363(9416):1187–1192.

Liang JT, Shieh MJ, Chen CN, Cheng YM, Chang KJ, Wang SM. Prospective evaluation of laparoscopy-assisted colectomy versus laparotomy with resection for management of complex polyps of the sigmoid colon. *World J Surg* 2002;26(3):377–383.

Lindgren PG, Nordgren SR, Oresland T, Hulten L. Midline or transverse abdominal incision for right-sided colon cancer-a randomized trial. *Colorectal Dis* 2001;3(1):46–50.

Liu SS, Carpenter RL, Mackey DC, Thirlby RC, Rupp SM, Shine TS, Feinglass NG, Metzger PP, Fulmer JT, Smith SL. Effects of perioperative analgesic technique on rate of recovery after colon surgery. *Anesthesiology* 1995;83(4):757–765.

Maartense S, Dunker MS, Slors JF, Cuesta MA, Gouma DJ, van Deventer SJ, van Bodegraven AA, Bemelman WA. Hand-assisted laparoscopic versus open restorative proctocolectomy with ileal pouch anal anastomosis: a randomized trial. *Ann Surg* 2004;240(6): 984–991.

MacKay G, Fearon K, McConnachie A, Serpell MG, Molloy RG, O’Dwyer PJ. Randomized clinical trial of the effect of postoperative intravenous fluid restriction on recovery after elective colorectal surgery. *Br J Surg* 2006;93(12): 1469–1474.

Marcello PW, Fleshman JW, Milsom JW, Read TE, Arnell TD, Birnbaum EH, Feingold DL, Lee SW, Mutch MG, Sonoda T, Yan Y, Whelan RL. Hand-assisted laparoscopic vs. laparoscopic colorectal surgery: a multicenter, prospective, randomized trial. *Dis Colon Rectum* 2008;51(6): 818-826; discussion 826–818.

McDonnell JG, O’Donnell B, Curley G, Heffernan A, Power C, Laffey JG. The analgesic efficacy of transversus abdominis plane block after abdominal surgery: a prospective randomized controlled trial. *Anesth Analg* 2007;104(1): 193–197.

Motamed S, Klubien K, Edwardes M, Mazza L, Carli F. Metabolic changes during recovery in normothermic versus hypothermic patients undergoing surgery and receiving general anesthesia and epidural local anesthetic agents. *Anesthesiology* 1998;88(5):1211–1218.

Neudecker J, Schwenk W, Junghans T, Pietsch S, Bohm B, Muller JM. Randomized controlled trial to examine the influence of thoracic epidural analgesia on postoperative ileus after laparoscopic sigmoid resection. *Br J Surg* 1999;86(10): 1292–1295.

Nightingale JJ, Knight MV, Higgins B, Dean T. Randomized, double-blind comparison of patient-controlled epidural infusion vs nurse-administered epidural infusion for postoperative analgesia in patients undergoing colonic resection. *Br J Anaesth* 2007;98(3): 380–384.

Nitschke LF, Schlosser CT, Berg RL, Selthafner JV, Wengert TJ, Avecilla CS. Does patient-controlled analgesia achieve better control of pain and fewer adverse effects than intramuscular analgesia? A prospective randomized trial. *Arch Surg* 1996;131(4):417–423.

Polglase AL, McMurrick PJ, Simpson PJ, Wale RJ, Carne PW, Johnson W, Chee J, Ooi CW, Chong JW, Kingsland SR, Buchbinder R. Continuous wound infusion of local anesthetic for the control of pain after elective abdominal colorectal surgery. *Dis Colon Rectum* 2007;50(12): 2158–2167.

Scheinin B, Asantila R, Orko R. The effect of bupivacaine and morphine on pain and bowel function after colonic surgery. *Acta Anaesthesiol Scand* 1987;31(2):161–164.

Schlachta CM, Burpee SE, Fernandez C, Chan B, Mamazza J, Poulin EC. Optimizing recovery after laparoscopic colon surgery (ORAL-CS): effect of intravenous ketorolac on length of hospital stay. *Surg Endosc* 2007;21(12): 2212–2219.

Schricker T, Wykes L, Eberhart L, Carli F, Meterissian S. Randomized clinical trial of the anabolic effect of hypocaloric parenteral nutrition after abdominal surgery. *Br J Surg* 2005;92(8): 947–953.

Schulze S, Sommer P, Bigler D, Honnens M, Shenkin A, Cruickshank AM, Bukhave K, Kehlet H. Effect of combined prednisolone, epidural analgesia, and indomethacin on the systemic response after colonic surgery. *Arch Surg* 1992;127(3):325–331.

Schulze S, Andersen J, Overgaard H, Norgard P, Nielsen HJ, Aasen A, Gottrup F, Kehlet H. Effect of prednisolone on the systemic response and wound healing after colonic surgery. *Arch Surg* 1997;132(2):129–135.

Schulze S, Lyng KM, Bugge K, Perner A, Bendtsen A, Thorup J, Nielsen HJ, Rasmussen V, Rosenberg J. Cardiovascular and respiratory changes and convalescence in laparoscopic colonic surgery: comparison between carbon dioxide pneumoperitoneum and gasless laparoscopy. *Arch Surg* 1999;134(10): 1112–1118.

Schwenk W, Bohm B, Muller JM. Postoperative pain and fatigue after laparoscopic or conventional colorectal resections. A prospective randomized trial. *Surg Endosc* 1998;12(9):1131–1136.

Scott NB, James K, Murphy M, Kehlet H. Continuous thoracic epidural analgesia versus combined spinal/thoracic epidural analgesia on pain, pulmonary function and the metabolic response following colonic resection. *Acta Anaesthesiol Scand* 1996;40(6):691–696.

Senagore AJ, Delaney CP, Mekhail N, Dugan A, Fazio VW. Randomized clinical trial comparing epidural anaesthesia and patient-controlled analgesia after laparoscopic segmental colectomy. *Br J Surg* 2003;90(10): 1195–1199.

Sim R, Cheong DM, Wong KS, Lee BM, Liew QY. Prospective randomized, double-blind, placebo-controlled study of pre- and postoperative administration of a COX-2-specific inhibitor as opioid-sparing analgesia in major colorectal surgery. *Colorectal Dis* 2007;9(1): 52–60.

Simpson T, Wahl G, DeTraglia M, Speck E, Taylor D. A pilot study of pain, analgesia use, and pulmonary function after colectomy with or without a preoperative bolus of epidural morphine. *Heart Lung* 1993;22(4):316–327.

Sjostrom S, Blass J. Postoperative analgesia with epidural bupivacaine and low-dose fentanyl—a comparison of two concentrations. *Acta Anaesthesiol Scand* 1998;42(7):776–782.

Stage JG, Schulze S, Moller P, Overgaard H, Andersen M, Rebsdorf-Pedersen VB, Nielsen HJ. Prospective randomized study of laparoscopic versus open colonic resection for adenocarcinoma. *Br J Surg* 1997;84(3):391–396.

Steinberg RB, Liu SS, Wu CL, Mackey DC, Grass JA, Ahlen K, Jeppsson L. Comparison of ropivacaine-fentanyl patient-controlled epidural analgesia with morphine intravenous patient-controlled analgesia for perioperative analgesia and recovery after open colon surgery. *J Clin Anesth* 2002;14(8):571–577.

Taqi A, Hong X, Mistraletti G, Stein B, Charlebois P, Carli F. Thoracic epidural analgesia facilitates the restoration of bowel function and dietary intake in patients undergoing laparoscopic colon resection using a traditional, nonaccelerated, perioperative care program. *Surg Endosc* 2007;21(2): 247–252.

Targarona EM, Balague C, Cerdan G, Espert JJ, Lacy AM, Visa J, Trias M. Hand-assisted laparoscopic splenectomy (HALS) in cases of splenomegaly: a comparison analysis with conventional laparoscopic splenectomy. *Surg Endosc* 2002;16(3): 426–430.

Tusek DL, Church JM, Strong SA, Grass JA, Fazio VW. Guided imagery: a significant advance in the care of patients undergoing elective colorectal surgery. *Dis Colon Rectum* 1997;40(2):172–178.

Watters JM, March RJ, Desai D, Monteith K, Hurtig JB. Epidural anaesthesia and analgesia do not affect energy expenditure after major abdominal surgery. *Can J Anaesth* 1993;40(4):314–319.

Weeks JC, Nelson H, Gelber S, Sargent D, Schroeder G. Short-term quality-of-life outcomes following laparoscopic-assisted colectomy vs open colectomy for colon cancer: a randomized trial. *Jama* 2002;287(3):321–328.

Wordliczek J, Banach M, Garlicki J, Jakowicka-Wordliczek J, Dobrogowski J. Influence of pre- or intraoperational use of tramadol (preemptive or preventive analgesia) on tramadol requirement in the early postoperative period. *Pol J Pharmacol* 2002;54(6):693–697.

Xu Y, Tan Z, Chen J, Lou F, Chen W. Intravenous flurbiprofen axetil accelerates restoration of bowel function after colorectal surgery. *Can J Anaesth* 2008;55(7): 414–422.

Yeh CC, Jao SW, Huh BK, Wong CS, Yang CP, White WD, Wu CT. Preincisional dextromethorphan combined with thoracic epidural anesthesia and analgesia improves postoperative pain and bowel function in patients undergoing colonic surgery. *Anesth Analg* 2005;100(5): 1384–1389, table of contents.

Zarauza R, Saez-Fernandez AN, Iribarren MJ, Carrascosa F, Adame M, Fidalgo I, Monedero P. A comparative study with oral nifedipine, intravenous nimodipine, and magnesium sulfate in postoperative analgesia. *Anesth Analg* 2000;91(4):938–943.

Zingg U, Miskovic D, Pasternak I, Meyer P, Hamel CT, Metzger U. Effect of bisacodyl on postoperative bowel motility in elective colorectal surgery: a prospective, randomized trial. *Int J Colorectal Dis* 2008;23(12): 1175–1183.

Zutshi M, Delaney CP, Senagore AJ, Mekhail N, Lewis B, Connor JT, Fazio VW. Randomized controlled trial comparing the controlled rehabilitation with early ambulation and diet pathway versus the controlled rehabilitation with early ambulation and diet with preemptive epidural anesthesia/analgesia after laparotomy and intestinal resection. *Am J Surg* 2005;189(3): 268–272.

#### D. Colonic Resection: Excluded references

Adriaenssens G, Vermeyen KM, Hoffmann VL, Mertens E, Adriaensen HF. Postoperative analgesia with i.v. patient-controlled morphine: effect of adding ketamine. *Br J Anaesth* 1999;83(3):393–396.

Albert JM, Talbott TM. Patient-controlled analgesia vs. conventional intramuscular analgesia following colon surgery. *Dis Colon Rectum* 1988;31(2):83–86. Anonymous.

Azma T, Kawai K, Okida M, Okada K, Tamura H. Use of the laryngeal mask airway in combination with regional anesthesia facilitates induction and emergence from general anesthesia in patients undergoing colorectal surgery. *Hiroshima J Med Sci* 2002;51(4):89–92.

Baker RP, Titu LV, Hartley JE, Lee PW, Monson JR. A case-control study of laparoscopic right hemicolectomy vs. open right hemicolectomy. *Dis Colon Rectum* 2004;47(10): 1675-1679.

Belda FJ, Aguilera L, Garcia de la Asuncion J, Alberti J, Vicente R, Ferrandiz L, Rodriguez R, Company R, Sessler DI, Aguilar G, Botello SG, Orti R. Supplemental perioperative oxygen and the risk of surgical wound infection: a randomized controlled trial. *JAMA* 2005;294(16): 2035-2042.

Brown SR, Goodfellow PJ, Adam IJ, Shorthouse AJ. A randomised controlled trial of transverse skin crease vs. vertical midline incision for right hemicolectomy. *Tech Coloproctol* 2004;8(1): 15-18.

Boudreault D, Brasseur L, Samii K, Lemoing JP. Comparison of continuous epidural bupivacaine infusion plus either continuous epidural infusion or patient-controlled epidural injection of fentanyl for postoperative analgesia. *Anesth Analg* 1991;73(2):132–137.

Bourget JL, Clark J, Joy N. Comparing preincisional with postincisional bupivacaine infiltration in the management of postoperative pain. *Arch Surg* 1997;132(7):766–769.

Braga M, Vignali A, Gianotti L, Zuliani W, Radaelli G, Gruarin P, Dellabona P, Di Carlo V. Laparoscopic versus open colorectal surgery: a randomized trial on short-term outcome. *Ann Surg* 2002;236(6):759–766.

Cali RL, Meade PG, Swanson MS, Freeman C. Effect of Morphine and incision length on bowel function after colectomy. *Dis Colon Rectum* 2000;43(2):163–168.

Chen JH, Hsieh CB, Chao PC, Liu HD, Chen CJ, Liu YC, Yu JC. Effect of water-soluble contrast in colorectal surgery: a prospective randomized trial. *World J Gastroenterol* 2005;11(18): 2802-2805.

de Leon-Casasola OA, Parker BM, Lema MJ, Groth RI, Orsini-Fuentes J. Epidural analgesia versus intravenous patient-controlled analgesia. Differences in the postoperative course of cancer patients. *Reg Anesth* 1994;19(5):307–315.

Delaney CP, Weese JL, Hyman NH, Bauer J, Techner L, Gabriel K, Du W, Schmidt WK, Wallin BA. Phase III trial of alvimopan, a novel, peripherally acting, mu opioid antagonist, for postoperative ileus after major abdominal surgery. *Dis Colon Rectum* 2005;48(6): 1114-1125.

Egbert AM, Lampros LL, Parks LL. Effects of patient-controlled analgesia on postoperative anxiety in elderly men. *Am J Crit Care* 1993;2(2):118–124.

Espin-Basany E, Sanchez-Garcia JL, Lopez-Cano M, Lozoya-Trujillo R, Medarde-Ferrer M, Armadans-Gil L, Alemany-Vilches L, Armengol-Carrasco M. Prospective, randomised study on antibiotic prophylaxis in colorectal surgery. Is it really necessary to use oral antibiotics? *Int J Colorectal Dis* 2005;20(6): 542-546.

Fearon KC, Ljungqvist O, Von Meyenfeldt M, Revhaug A, Dejong CH, Lassen K, Nygren J, Hausel J, Soop M, Andersen J, Kehlet H. Enhanced recovery after surgery: a consensus review of clinical care for patients undergoing colonic resection. *Clin Nutr* 2005;24(3): 466-477.

Ferraz AA, Cowles VE, Condon RE, Carilli S, Ezberci F, Frantzides CT, Schulte WJ. Nonopioid analgesics shorten the duration of postoperative ileus. *Am Surg* 1995;61(12):1079–1083.

Frantzides CT, Cowles V, Salaymeh B, Tekin E, Condon RE. Morphine effects on human colonic myoelectric activity in the postoperative period. *Am J Surg* 1992;163(1):144–148.

Gendall KA, Raniga S, Kennedy R, Frizelle FA. The impact of obesity on outcome after major colorectal surgery. *Dis Colon Rectum* 2007;50(12): 2223–2237.

Greer SM, Dalton JA, Carlson J, Youngblood R. Surgical patients' fear of addiction to pain medication: the effect of an educational program for clinicians. *Clin J Pain* 2001;17(2):157–164.

HALS Study Group. Hand-assisted laparoscopic surgery vs standard laparoscopic surgery for colorectal disease: a prospective randomized trial. *Surg Endosc* 2000;14(10):896–901.

Han-Geurts IJ, Hop WC, Kok NF, Lim A, Brouwer KJ, Jeekel J. Randomized clinical trial of the impact of early enteral feeding on postoperative ileus and recovery. *Br J Surg* 2007;94(5): 555–561.

Hasegawa H, Kabeshima Y, Watanabe M, Yamamoto S, Kitajima M. Randomized controlled trial of laparoscopic versus open colectomy for advanced colorectal cancer. *Surg Endosc* 2003;17(4): 636–640.

Huilgol RL, Wright CM, Solomon MJ. Laparoscopic versus open ileocolic resection for Crohn's disease. *J Laparoendosc Adv Surg Tech A* 2004;14(2): 61–65.

Jayr C, Beaussier M, Gustafsson U, Letournier Y, Nathan N, Plaud B, Tran G, Varlet C, Marty J. Continuous epidural infusion of ropivacaine for postoperative analgesia after major abdominal surgery: comparative study with i.v. PCA morphine. *Br J Anaesth* 1998;81(6):887–892.

Jensen MP, Chen C, Brugger AM. Postsurgical pain outcome assessment. *Pain* 2002;99(1–2):101–109.

Joels CS, Mostafa G, Matthews BD, Kercher KW, Sing RF, Norton HJ, Heniford BT. Factors affecting intravenous analgesic requirements after colectomy. *J Am Coll Surg* 2003;197(5): 780-785.

Joshi GP, Ogunnaike BO. Consequences of inadequate postoperative pain relief and chronic persistent postoperative pain. *Anesthesiol Clin North America* 2005;23(1): 21–36.

Kearns SR, Connolly EM, McNally S, McNamara DA, Deasy J. Randomized clinical trial of diathermy versus scalpel incision in elective midline laparotomy. *Br J Surg* 2001;88(1):41–44.

Kehlet H, Mogensen T. Hospital stay of 2 days after open sigmoidectomy with a multimodal rehabilitation programme. *Br J Surg* 1999;86(2):227–230.

Khoo CK, Vickery CJ, Forsyth N, Vinall NS, Eyre-Brook IA. A prospective randomized controlled trial of multimodal perioperative management protocol in patients undergoing elective colorectal resection for cancer. *Ann Surg* 2007;245(6): 867-872.

Klarenbeek BR, Veenhof AA, de Lange ES, Bemelman WA, Bergamaschi R, Heres P, Lacy AM, van den Broek WT, van der Peet DL, Cuesta MA. The Sigma-trial protocol: a prospective double-blind multi-centre comparison of laparoscopic versus open elective sigmoid resection in patients with symptomatic diverticulitis. *BMC Surg* 2007;7: 16.

Kobayashi M, Mohri Y, Tonouchi H, Miki C, Nakai K, Kusunoki M. Randomized clinical trial comparing intravenous antimicrobial prophylaxis alone with oral and intravenous antimicrobial prophylaxis for the prevention of a surgical site infection in colorectal cancer surgery. *Surg Today* 2007;37(5): 383-388.

Kong SK, Onsiong SM, Chiu WK, Li MK. Use of intrathecal morphine for postoperative pain relief after elective laparoscopic colorectal surgery. *Anaesthesia* 2002;57(12):1168–1173.

Krogh B, Jorn Jensen P, Henneberg SW, Hole P, Kronborg O. Nitrous oxide does not influence operating conditions or postoperative course in colonic surgery. *Br J Anaesth* 1994;72(1):55–57.

Kumar S, Kumar M, Gupta R. Keterolac vs Nefopam: comparison of single intravenous dose relieving post-operative pain following laparotomy. *Indian Journal of Pharmacology* 1996;28:240–243. Kumar CM, Corbett WA, Wilson RG. Spinal anaesthesia with a micro-catheter in high-risk patients undergoing colorectal cancer and other major abdominal surgery. *Surg Oncol* 2008;17(2): 73-79.

Lai A, Hung CT. Effect of age on recovery from remifentanil anaesthesia. *Anaesth Intensive Care* 2001;29(5):506–509.

Larsen VH, Iversen AD, Christensen P, Andersen PK. Postoperative pain treatment after upper abdominal surgery with epidural morphine at thoracic or lumbar level. *Acta Anaesthesiol Scand* 1985;29(6):566–571.

Lawes D, Taylor I. Recent randomised trials in colorectal disease. *Colorectal Dis* 2005;7(1): 8–17.

Lezoche E, Feliciotti F, Paganini AM, Guerrieri M, Campagnacci R, De Sanctis A. Laparoscopic colonic resections versus open surgery: a prospective non-randomized study on 310 unselected cases. *Hepatogastroenterology* 2000;47(33):697–708.

Lordan JT, Tilney HS, Shirol S, Jourdan I, Gudgeon AM. Does the laparoscopic colorectal surgery learning curve adversely affect the results of colorectal cancer resection? A 3-year prospective study in a district general hospital. *Colorectal Dis* 2008;10(4): 363–369.

Mann C, Pouzeratte Y, Boccard G, Peccoux C, Vergne C, Brunat G, Domergue J, Millat B, Colson P. Comparison of intravenous or epidural patient-controlled analgesia in the elderly after major abdominal surgery. *Anesthesiology* 2000;92(2):433–441.

Mayzler O, Weksler N, Domchik S, Klein M, Mizrahi S, Gurman GM. Does supplemental perioperative oxygen administration reduce the incidence of wound infection in elective colorectal surgery? *Minerva Anestesiologica* 2005;71(1-2): 21–25.

Melbert RB, Kimmins MH, Isler JT, Billingham RP, Lawton D, Salvadalena G, Cortezzo M, Rowbotham R. Use of a critical pathway for colon resections. *J Gastrointest Surg* 2002;6(5):745–752.

Milsom JW, Hammerhofer KA, Bohm B, Marcello P, Elson P, Fazio VW. Prospective, randomized trial comparing laparoscopic vs. conventional surgery for refractory ileocolic Crohn's disease. *Dis Colon Rectum* 2001;44(1):1–8.

Moiniche S, Bulow S, Hesselfeldt P, Hestbaek A, Kehlet H. Convalescence and hospital stay after colonic surgery with balanced analgesia, early oral feeding, and enforced mobilisation. *Eur J Surg* 1995;161(4):283–288.

Morimoto H, Cullen JJ, Messick JM, Jr., Kelly KA. Epidural analgesia shortens postoperative ileus after ileal pouch-anal canal anastomosis. *Am J Surg* 1995;169(1):79–82.

Nelson H, Sargent D, Wieand HS, et al; for the Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. *N Engl J Med* 2004; 350: 2050-2059. *Cancer Treat Rev* 2004;30(8): 707–709.

Neudecker J, Schwenk W, Junghans T, Pietsch S, Bohm B, Muller JM. Randomized controlled trial to examine the influence of thoracic epidural analgesia on postoperative ileus after laparoscopic sigmoid resection. *Br J Surg* 1999;86(10):1292–1295.

Neudecker J, Junghans T, Ziemer S, Raue W, Schwenk W. Effect of laparoscopic and conventional colorectal resection on peritoneal fibrinolytic capacity: a prospective randomized clinical trial. *Int J Colorectal Dis* 2002;17(6):426–429.

Niloff PH. Chewing gum may be efficacious in patients not receiving continuous postoperative epidural analgesia. *Colorectal Dis* 2007;9(7): 666-667.

Omote K. Intravenous Lidocaine to Treat Postoperative Pain Management: Novel Strategy with a Long-established Drug. *Anesthesiology* 2007;106(1): 5-6

Petrelli NJ, Cheng C, Driscoll D, Rodriguez-Bigas MA. Early postoperative oral feeding after colectomy: an analysis of factors that may predict failure. *Ann Surg Oncol* 2001;8(10):796-800.

Peyton PJ, Myles PS, Silbert BS, Rigg JA, Jamrozik K, Parsons R. Perioperative epidural analgesia and outcome after major abdominal surgery in high-risk patients. *Anesth Analg* 2003;96(2):548-554..

Pietrabissa A, Moretto C, Carobbi A, Boggi U, Ghilli M, Mosca F. Hand-assisted laparoscopic low anterior resection: initial experience with a new procedure. *Surg Endosc* 2002;16(3):431-435.

Quah HM, Samad A, Neathley AJ, Hay DJ, Maw A. Does gum chewing reduce postoperative ileus following open colectomy for left-sided colon and rectal cancer? A prospective randomized controlled trial. *Colorectal Dis* 2006;8(1): 64-70.

Renzi C, Peticca L, Pescatori M. The use of relaxation techniques in the perioperative management of proctological patients: preliminary results. *Int J Colorectal Dis* 2000;15(5-6):313-316.

Schulze S, Lyng KM, Bugge K, Perner A, Bendtsen A, Thorup J, Nielsen HJ, Rasmussen V, Rosenberg J. Cardiovascular and respiratory changes and convalescence in laparoscopic colonic surgery: comparison between carbon dioxide pneumoperitoneum and gasless laparoscopy. *Arch Surg* 1999;134(10):1112-1118.

Scott DA, Blake D, Buckland M, Etches R, Halliwell R, Marsland C, Merridew G, Murphy D, Paech M, Schug SA, Turner G, Walker S, Huizar K, Gustafsson U. A comparison of epidural ropivacaine infusion alone and in combination with 1, 2, and 4 microg/mL fentanyl for seventy-two hours of postoperative analgesia after major abdominal surgery. *Anesth Analg* 1999;88(4):857-864.

Shapiro A, Zohar E, Hoppenstein D, Ifrach N, Jedeikin R, Fredman B. A comparison of three techniques for acute postoperative pain control following major abdominal surgery. *J Clin Anesth* 2003;15(5): 345-350.

Senagore AJ, Delaney CP, Mekhail N, Dugan A, Fazio VW. Randomized clinical trial comparing epidural anaesthesia and patient-controlled analgesia after laparoscopic segmental colectomy. *Br J Surg* 2003;90(10):1195–1199.

Tang CL, Jayne DG, Seow-Choen F, Ng YY, Eu KW, Mustapha N. A randomized controlled trial of 0.5% ferric hyaluronate gel (Intergel) in the prevention of adhesions following abdominal surgery. *Ann Surg* 2006;243(4): 449–455.

Targarona EM, Gracia E, Garriga J, Martinez-Bru C, Cortes M, Boluda R, Lerma L, Trias M. Prospective randomized trial comparing conventional laparoscopic colectomy with hand-assisted laparoscopic colectomy: applicability, immediate clinical outcome, inflammatory response, and cost. *Surg Endosc* 2002;16(2):234–239.

Telfer JR, Canning G, Galloway DJ. Comparative study of abdominal incision techniques. *Br J Surg* 1993;80(2):233–235. Tjandra JJ, Chan MK, Yeh CH. Laparoscopic- vs. hand-assisted ultralow anterior resection: a prospective study. *Dis Colon Rectum* 2008;51(1): 26–31.

Trimbos JB, Smit IB, Holm JP, Hermans J. A randomized clinical trial comparing two methods of fascia closure following midline laparotomy. *Arch Surg* 1992;127(10):1232–1234.

Tsunoda A, Nakao K, Hiratsuka K, Tsunoda Y, Kusano M. Prospective analysis of quality of life in the first year after colorectal cancer surgery. *Acta Oncol* 2007;46(1): 77–82.

Valverde A, Msika S, Kianmanesh R, Hay JM, Couchard AC, Flamant Y, Fingerhut A, Fagniez PL. Povidone-iodine vs sodium hypochlorite enema for mechanical preparation before elective open colonic or rectal resection with primary anastomosis: a multicenter randomized controlled trial. *Arch Surg* 2006;141(12): 1168–1174.

Van Assche G, D’Haens G, Noman M, Vermeire S, Hiele M, Asnong K, Arts J, D’Hoore A, Penninckx F, Rutgeerts P. Randomized, double-blind comparison of 4 mg/kg versus 2 mg/kg intravenous cyclosporine in severe ulcerative colitis. *Gastroenterology* 2003;125(4): 1025–1031.

Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Bonjer HJ, Haglind E, Pahlman L, Cuesta MA, Msika S, Morino M, Lacy AM. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. *Lancet Oncol* 2005;6(7): 477–484.

Wakeling HG, McFall MR, Jenkins CS, Woods WG, Miles WF, Barclay GR, Fleming SC. Intraoperative oesophageal Doppler guided fluid management shortens postoperative hospital stay after major bowel surgery. *Br J Anaesth* 2005;95(5): 634–642.

Werner MU, Gaarn-Larsen L, Basse L, Jakobsen DH, Lund C, Billesbolle P, Kehlet H. Postoperative pain and gastro-intestinal recovery after colonic resection with epidural analgesia and multimodal rehabilitation. *Acute Pain* 2005;7(1): 5–11.

Wichmann MW, Eben R, Angele MK, Brandenburg F, Goetz AE, Jauch KW. Fast-track rehabilitation in elective colorectal surgery patients: a prospective clinical and immunological single-centre study. *ANZ J Surg* 2007;77(7): 502–507.

Wise PE. Does single, low-dose preoperative dexamethasone improve outcomes after colorectal surgery based on an enhanced recovery protocol? Double-blind, randomized clinical trial *Diseases of the Colon and Rectum* 2008;51(8): 1303.

Wissing J, van Vroonhoven TJ, Schattenkerk ME, Veen HF, Ponsen RJ, Jeekel J. Fascia closure after midline laparotomy: results of a randomized trial. *Br J Surg* 1987;74(8):738–741.

Yoshioka K, Connolly AB, Ogunbiyi OA, Hasegawa H, Morton DG, Keighley MR. Randomized trial of oral sodium phosphate compared with oral sodium picosulphate (Picolax) for elective colorectal surgery and colonoscopy. *Dig Surg* 2000;17(1):66–70.

## E. Colonic Resection: Reasons for exclusion

<b>Study</b>	<b>Reason for exclusion</b>
Adriaenssens G 1999	No defined sub-group
Albert JM 1988	No VAS pain assessment
Anonymous 2000	No VAS pain assessment
Azma T 2002	No VAS pain assessment
Baker RP 2004	No VAS pain assessment
Belda FJ 2005	No VAS pain assessment
Boudreault D 1991	Laparotomy procedure not defined
Bourget JL 1997	Laparotomy procedure not defined
Braga M 2002	No VAS pain assessment
Brown SR 2004	No VAS pain assessment
Cali RL 2000	No VAS pain assessment
Chen J 2005	No VAS pain assessment
De Leon-Casasola OA 1994	No defined sub-group
Delaney CP 2005	No defined sub-group
Egbert AM 1993	No defined sub-group
Espin-Basany E 2005	No VAS pain assessment
Fearon KC 2005	Review article
Ferraz AA 1995	No VAS pain assessment

Frantzides CT 1992	Not a comparative study
Gendall KA 2007	Review article
Greer SM 2001	No sub-group analysis of pain
Han-Geurts 2007	No defined sub-group
Hasegawa 2003	No VAS pain assessment
Huilgol 2004	Not randomised, no VAS pain assessment
Jayr C 1998	No defined sub-group
Jensen MP 2002	Not colonic resection
Joels CS 2005	Not a randomised controlled trial
Joshi GP 2005	Not a randomised controlled trial
Kallio H 2005	No defined sub-group, No VAS pain assessment
Kearns SR 2001	No defined sub-group
Kehlet H 1999	Not a comparative study
Khoo CK 2007	No VAS pain assessment
Klarenbeek BR 2007	Reports methodology only; no results
Kobayashi M 2007	No VAS pain assessment
Krogh B 1994	No VAS pain assessment
Kumar S 1996	No defined sub-group
Kumar CM 2008	No VAS pain assessment; not randomised
Lai A 2001	No defined sub-group
Larsen VH 1985	No defined sub-group

Lawes D 2005	Review article
Lezoche E 2000	Non-randomized, no VAS pain assessment
Lordan JT 2008	No VAS pain assessment, not randomised
Mann C 2000	No defined sub-group
Mayzler 2005	No VAS pain assessment,
Melbert RB 2002	No VAS pain assessment
Milsom JW 2001	No VAS pain assessment
Moiniche S 1995	Not a comparative study
Morimoto H 1995	Retrospective study
Neudecker J 2002	Review article
Nelson H 2004	No VAS pain assessment
Niloff PH 2007	Non-randomized
Omote K 2007	Short Review article
Petrelli NJ 2001	No VAS pain assessment
Peyton PJ 2003	No defined sub-group or VAS pain assessment
Pietrabissa A 2002	Not randomized, pilot study
Quah HM 2006	No VAS pain assessment
Renzi C 2000	Not relevant to colonic resection
Scott DA 1999	No defined sub-group
Shapiro A 2003	Not randomised
Tang C-L 2006	VAS pain assessment

Telfer JR 1993	No defined sub-group
Tjandra JJ 2008	Not randomised
Trimbos JB 1992	No defined sub-group
Tsunoda A 2005	No VAS pain assessment
Valverde A 2006	No VAS pain assessment
Van Assche G 2003	No VAS pain assessment
Veldkamp R 2005	No VAS pain assessment
Wakeling HG 2005	No VAS pain assessment
Werner MU 2005	Not randomised
Wichmann MW 2007	Not randomised
Wise PE 2008	Abstract; not a full paper
Wissing J 1987	No VAS pain assessment and no defined sub-group
Yoshioka K 2000	VAS pain scores reported intra-operatively