Randomized clinical trial of local bupivacaine perfusion *versus* parenteral morphine infusion for pain relief after laparotomy

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Background: Opioids are often used to decrease pain following laparotomy but are associated with unwanted side-effects. The effectiveness of local perfusion of bupivacaine 0·5 per cent following laparotomy was studied.

Methods: A prospective randomized study involving patients undergoing laparotomy for major colorectal surgery using a left iliac fossa skin crease incision was undertaken. Patients were randomized to receive either intermittent intravenous morphine infusion on demand with patient-controlled analgesia (PCA group) or continuous wound perfusion of local bupivacaine 0·5 per cent for 60 h (LA group).

Results: Seventy patients were recruited, 35 in each group. Patient demographics, surgical and recovery variables and complications were comparable in the two groups. The wound lengths were similar (median 14 cm in both groups). There was no statistically significant difference in postoperative pain scores at rest and with movement between the two groups, except for pain scores at rest on the first postoperative day ($P = 0·03$). The median total amount of morphine used was significantly greater in the PCA group (median 38 *versus* 0 mg in the LA group; $P < 0·001$).

Conclusion: Direct continuous local wound perfusion of bupivacaine 0·5 per cent is as effective as PCA for postoperative pain relief after laparotomy. It is a safe and feasible alternative to parenteral opioids.

Paper accepted 2 November 2000 British Journal of Surgery 2001, 88, 357–359

Introduction

Although parenteral opioids remain the mainstay for decreasing postoperative pain, they are associated with serious side-effects such as nausea, excessive sedation and respiratory depression. Although the dosage of opioids and associated side-effects can be reduced by use of a patient-controlled analgesia (PCA) system, these techniques are still associated with serious side-effects. Recently Partridge and Stubile[1] reported that long-acting local anaesthetics were highly effective for postoperative pain control. Wound infusion with local anaesthesia for the relief of postoperative pain has been shown to be useful previously[2–13].

The objective of this study was to explore the effect of direct continuous wound perfusion with bupivacaine 0·5 per cent on postoperative pain score, postoperative narcotic requirements and postoperative morbidity compared with patient-controlled opioid-based continuous infusion.

Patients and methods

A prospective randomized study was conducted from September 1999 to January 2000. Seventy consecutive patients (American Society of Anesthesiologists I–III with no history of hypersensitivity to bupivacaine or morphine), who underwent elective colectomy using a left iliac fossa skin crease incision, were recruited. They were randomized to receive either continuous subcutaneous wound infusion with bupivacaine 0·5 per cent via the ON-Q™ pain management system (Ethicon Endo-Surgery, Cincinnati, Ohio, USA) (LA group) or intermittent intravenous morphine infusion on demand with a PCA system (PCA group) for postoperative pain management.

All patients underwent standard colectomy with preoperative bowel preparation, prophylactic antibiotics and anticoagulation. All wounds were closed using a mass closure technique employing monofilament synthetic suture. Subcutaneous closure was not used and the skin

was stapled. Patients in the PCA group received intravenous morphine for 60 h in amounts of 1–3 mg/h on demand via the PCA pump. The initial infusion rate was 1 mg/h. This was increased to a maximum of 3 mg/h if pain control was insufficient. For patients in the LA group a combination of 20 ml lignocaine 1 per cent and 20 ml bupivacaine 0·5 per cent was infiltrated into the peritoneum, muscles and subcutaneous tissue under direct vision before closure of the anterior abdominal wall. A small catheter was then inserted through a separate stab wound into the subcutaneous layer of the wound. This catheter was connected to the ON-Q™ pump, which was preloaded with 120 ml bupivacaine 0·5 per cent and infused continuously into the wound at a flow rate of 2 ml/h for 60 h. Subcutaneous morphine for breakthrough pain was given to patients in the LA group whenever requested.

Postoperative pain at rest and on movement was measured using a visual analogue scale (0 representing no pain and 10 the most severe pain) within 8 h of surgery and on the first, second and third days after operation. The amount of morphine used during the same period was also recorded. Other variables recorded included vital signs, sedation, confusional states, nausea, vomiting, chest infection, return of bowel function, time to postoperative ambulation, urinary retention, deep venous thrombosis and wound infection. All patients had a final wound examination at 4 weeks after operation.

Statistical analysis was performed using SPSS® (SPSS, Chicago, Illinois, USA). All data were examined for symmetry of distribution using stem and leaf plots. The variables were then compared and analysed using Fisher's exact test and Mann–Whitney *U* test. $P < 0.05$ was deemed to be statistically significant.

Results

Thirty-five patients (median age 64 (range 15–83) years; 22 men) were randomized to the PCA group and 35 patients (median age 61 (range 41–82) years; 20 men) to the LA group. Patient demographics were similar between the PCA and LA groups.

The median incision length for both groups was similar: 14 (range 6–25) cm in the PCA group *versus* 14 (range 10–32) cm in the LA group. Nine patients in the PCA group and 13 patients in the LA group had a stoma created as part of the surgical procedure ($P = 0.44$). Nine patients in the PCA group and 15 patients in the LA group had a drain inserted at the end of the operation ($P = 0.21$).

Postoperative pain scores were measured using the visual analogue scale at rest and on movement within 8 h of surgery, and on the first, second and third days after operation. There was no statistically significant difference in pain scores between the two groups at rest and with movement, except in the scores experienced at rest on the first postoperative day ($P = 0.03$). The median pain scores in the LA group were slightly higher than those in the PCA group on the day of operation but subsequently became identical. The median total amount of morphine used in the PCA group was significantly more than that in the LA group: 38 (range 12–181) *versus* 0 (range 0–20) mg ($P < 0.001$) (*Table 1*).

Table 1 Postoperative pain scores and total morphine requirement

	LA	PCA	P
Pain score			
At rest			
Day of operation	3 (0–8)	1 (0–8)	0·03
Day 1 after operation	2 (0–8)	0 (0–6)	0·03
Day 2 after operation	0 (0–4)	0 (0–6)	0·10
Day 3 after operation	0 (0–2)	0 (0–6)	0·01
During movement			
Day of operation	5 (0–10)	3 (0–10)	0·08
Day 1 after operation	3 (0–6)	3 (1–9)	0·17
Day 2 after operation	2 (0–7)	2 (1–6)	0·90
Day 3 after operation	1 (0–5)	1 (0–6)	0·88
Total morphine (mg)	0 (0–20)	38 (12–181)	< 0·001*

Values are median (range). LA, local anaesthesia; PCA, patient-controlled analgesia. *Fisher's exact test

None of the patients in either group was unduly sedated or confused owing to either form of analgesia during the study. Six patients in the PCA group compared with two patients in the LA group experienced vomiting ($P = 0.26$). Six patients in the PCA group compared with five patients in the LA group developed low-grade fever. There was no significant difference in the time to return of bowel movement in the two groups: median time to passage of flatus after operation 2 (range 0–4) days in the PCA group compared with 2 (range 1–4) days in the LA group. The median time to passing a bowel motion after operation was 3 (range 0–4) days in the PCA group compared with 3 (range 1–5) days in the LA group. None of the patients developed acute urinary retention after removal of the urinary catheter. The timing of postoperative mobilization was similar in both groups. No patient developed deep venous thrombosis.

Four patients in the LA group compared with one in the PCA group developed a wound infection ($P = 0.36$). Patients were discharged from hospital a median of 5 (range 3–64) days after operation in the PCA group compared with 6 (range 4–18) days in the LA group ($P = 0.42$).

Discussion

PCA with opioids is used widely for postoperative pain. The main disadvantage of parenteral opioids is their side-effects.

In this randomized clinical trial, the effectiveness of postoperative pain relief and the incidence of postoperative pain-related complications were compared in patients receiving direct wound infusion with local anaesthesia and PCA using opioid analgesia.

Skin crease incisions are thought by the present authors to result in less postoperative wound pain and have been used since the early 1990s to perform most major colorectal surgery. This study shows that the pain scores achieved using direct wound perfusion with bupivacaine 0·5 per cent are comparable to those achieved with PCA. Furthermore, only a minimal amount of morphine was needed in the LA group. In the present study, the catheter for perfusion of bupivacaine was inserted into the subcutaneous layer of the wound whereas other studies have reported catheter insertion between the rectal sheath and the peritoneum[2,6,8,9]. A mixed infiltration of long- and short-acting local anaesthesia (bupivacaine 0·5 per cent and lignocaine 1 per cent) was injected under direct vision into the peritoneum, muscle layer and subcutaneous fat before mass closure of the wound. In the LA group, 13 patients who had a stoma created and 15 patients who had a drain inserted had local anaesthesia infiltrated into the stoma or drain site at the end of the operation. Analgesia infusion was limited to the main wound alone. These patients neither experienced more pain nor demanded more 'rescue' morphine.

There is always a risk of overdose of bupivacaine from subcutaneous absorption, resulting in undesirable side-effects. In the present study the amount used was calculated to be below the maximum daily dose. No patient developed any untoward toxic effects. Reports in the literature show that the plasma concentration of bupivacaine after wound infiltration is well below the toxic threshold and may be reduced further when administered together with adrenaline[12,13].

Postoperative recovery was comparable between the LA and PCA groups. However, the total amount of morphine received by patients in the PCA group was much higher than that by patients in the LA group. One of the main attractions of the LA technique is the reduced (or absent) need for morphine for postoperative pain relief. The portability of the LA system used also allows easier mobilization than can be achieved with patients on parenteral opioids.

In conclusion, direct continuous subcutaneous wound perfusion with local anaesthesia provides effective postoperative pain relief in left lower quadrant skin crease laparotomy wounds. This technique is a feasible and safe alternative to patient-controlled morphine analgesia.

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