Original Article

Postoperative pain relief following abdominal operations: A prospective randomised study of comparison of patient controlled analgesia with conventional parenteral opioids

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ABSTRACT

Background: Parenteral opioids are traditionally used for pain management following abdominal operations. Patient Controlled Analgesia (PCA) is replacing the conventional method for postoperative pain relief nowadays. **Aims:** To find out the effectiveness of PCA in postoperative pain relief following abdominal operations. **Settings and Design:** This prospective randomised study was conducted in the Jawaharlal Institute of Post Graduate Medical Education and Research, Pondicherry, India. **Materials and Methods:** Sixty-two consecutive patients undergoing abdominal operations were randomly divided into PCA group (n=32) who received intravenous PCA morphine and IM group (n=30) who received conventional intramuscular morphine in the postoperative period. Morphine consumption, pain relief, detailed pulmonary function tests and side-effects of morphine were assessed. **Statistical Analysis:** This was performed by "Epi Info 2000 version 6". Chi-square and Students 't' tests were used to relate the variables. **Results:** The total morphine consumption of the PCA group was significantly lesser than IM group (mean 30.84 mg versus 37.36 mg *P*-0.015) and it was less at different intervals in the postoperative period. The PCA group had better pain relief when compared to the IM group (mean pain score 3.42 versus 4.97 $P<0.001$). Pulmonary function parameters did not show a significant difference at different intervals in the postoperative period except for Peak Expiratory Flow Rate. None of the patients had major morphine-related complications. **Conclusions:** Intravenous PCA provides better pain relief with less morphine consumption as compared to the conventional IM method. Recovery of postoperative pulmonary functions showed no significant difference in the two groups apart from Peak Expiratory Flow Rate, which showed significant early recovery in the PCA group.

Key Words: Pain relief, Patient controlled analgesia, Abdominal operations

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INTRODUCTION

In spite of recent advances in our understanding of pain mechanisms and the development of highly effective pain management methods, many patients needlessly continue to endure pain after surgery. In addition, upper abdominal operations typically produce significant pulmonary dysfunction in the postoperative period leading to a significant incidence of atelectasis and pneumonia. This is mainly due to incisional pain and muscle splinting causing restrictive respiratory dysfunction.[1] Patient Controlled Analgesia (PCA) is a new system used in postoperative pain relief which

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enables patients to self titrate analgesia to their desired pain relief and then to maintain it at that level.

Though there are already some studies comparing PCA with conventional intramuscular analgesia, the postoperative recovery of pulmonary function has not been assessed in detail.[2-4] The present study was undertaken to compare the postoperative pain relief, amount of opioid consumption and recovery of respiratory functions between patient controlled intravenous analgesia and conventional intramuscular opioid analgesia in patients undergoing abdominal operations.

PATIENTS AND METHODS

A prospective randomised study was conducted in 62 consecutive patients undergoing open abdominal operation from September 2000 to July 2002. The study was cleared by the ethical committee of the Institute. Patients with gross derangements in preoperative pulmonary function tests (PFT), morphine allergy, psychiatric and neurological disorders were excluded. The abdominal operations included Truncal vagotomy and Gastrojejunostomy (GJ) for Duodenal ulcer with Gastric outlet obstruction (n=13), Palliative anterior GJ for inoperable Ca. Stomach (n=14), Partial or Total Gastrectomy for operable Ca. Stomach (n=9), Open cholecystectomy (n=6), splenectomy (n=6), hemicolectomy (n=6) and others (n=8). The patients were randomised to receive either intravenous PCA morphine or conventional intramuscular (IM) morphine in the postoperative period. To conceal the allocation, envelope method of randomisation was used. Informed consent was obtained. Preoperatively, the patients were evaluated for risk factors for postoperative pulmonary derangements, like smoking, obesity, lung diseases and other medical illness.

The Pulmonary function tests (FEV1, VC and PEFR) were measured using bedside Spirometer (Spirobank MIR). The tests were repeated thrice and the best effort was recorded. PCA pump used was Graseby PCA Pump 3300. The premedications, induction, neuromuscular blocks and the intraoperative morphine were standardised for both the groups. The intraoperative morphine was given at a dose of 0.05 mg/kg before induction followed by 0.02 mg/kg every hour during the surgery. Local anaesthetics were not used at the incision site.

PCA Group

In the postoperative period, the PCA group received morphine according to PCA pump settings. They received morphine at a dose of 1mg/dose with 5-minute lockout interval. The maximum 2-hourly dose allowed was 0.1 mg/kg.

IM Group

The first dose of IM morphine (0.2 mg/kg) was given on first analgesic request and then repeated every 6 hours postoperatively. They also received on demand doses of IM morphine (0.05 mg/kg) when they experienced pain in between the 6-hourly doses.

The vital parameters, pain score and side-effects of morphine were recorded at regular intervals for 24 hours postoperatively. The PFTs were done at 6 h, 24 h, 48 h and 72 h postoperatively with the patient in the propped up position. The morphine consumption, visual analogue score and pulmonary function parameters were analysed in both the groups.

Statistical analysis

It was done by "Epi Info 2000 version 6". Chi-square test and Students 't' test were used to relate the variables. A "*P*" value of less than 0.05 was considered significant.

RESULTS

Thirty-two patients with mean age of 45 years (range 20-66 years) were randomised to the PCA group and thirty patients with mean age of 42 years (range 20-62 years) to the IM group. There were 23 males and 9 females in the PCA group as against 19 males and 11 females in the IM group. The patients' demographics were similar between the PCA and IM groups.

The total mean morphine requirement for adequate pain relief in the first 24 hours was less in the PCA group (30.84 mg +/-12.7 mg) when compared to the IM group (37.36 mg +/-6.56 mg), which is statistically significant. The average morphine consumption at different intervals also showed a statistically significant difference. In the IM group, 5 patients (17%) had to receive a supplementary dose (0.05 mg/kg) of morphine in between the 6-hourly doses (Table 1).

The overall pain scores were significantly low in the PCA group (3.42) when compared to the IM group (4.97). At different intervals, the pain scores were lower in the PCA group than the IM group and they were statistically significant. The pain scores were lower in the latter hours of the postoperative period in both the groups. However, the decline in pain scores over time was greater in the PCA group than the IM group (Table 2).

Table 1: Comparison of Morphine consumption in the postoperative period at different intervals

Postoperative period (in Hours)	*IM group Dose in mg Mean (95%CI)	PCA group Dose in mg Mean (95%CI)	*P* value
0-12	18.66 (17.24-20.08)	15.06 (14.10-16.02)	0.013
12+ to 24	18.70 (17.54-19.86)	15.21 (14.29-16.13)	0.024
Total in 24 h	37.36 (34.96-39.76)	30.84 (29.18-32.50)	0.015

Degree of freedom- 60

IM- Intramuscular; PCA- Patient controlled analgesia; CI- Confidence interval

*5 patients received one additional dose of morphine (0.05 mg/kg).

Table 2: Comparison of postoperative pain scores by visual analogue scale

Postoperative period (Hours)	IM group Mean (95% CI)	PCA group Mean (95% CI)	*P* value
0-6	5.34 (5.14-5.54)	4.44 (4.18-4.70)	0.002
6+ to 12	4.91 (4.67-5.15)	3.17 (3.01-3.33)	<0.001
12+ to 24	4.65 (4.41-4.89)	2.65 (2.53-2.77)	<0.001
Overall (0-24 hrs)	4.97 (4.83-5.11)	3.42 (3.24-3.60)	<0.001

Degree of freedom- 60

IM- Intramuscular; PCA- Patient controlled analgesia; CI- Confidence interval

The recovery of pulmonary function parameters was similar in both the groups except for PEFR. The PEFR showed better recovery in the PCA group during the first 24 hours (Table 3).

No major morphine-related complications were noted. None of the patients in either group was unduly sedated or had respiratory depression. Two patients in the IM group and 4 patients in the PCA group had nausea which subsided with Inj. Metoclopromide. Urinary retention was seen in 2 patients of the PCA group which needed urinary catheterisation.

DISCUSSION

The adequate treatment of pain is important not only from a humanitarian point of view but also from a physiological aspect. Pain produces tachycardia and hypertension leading to an increase in cardiac workload and risk of postoperative myocardial ischemia or infarction in high-risk patients. Abdominal and thoracic wounds result in ineffective respiration with production of hypoxia. Areas of spontaneous atelectasis may arise with regional underventilation, perfusion inequality and shunting of venous blood.[5]

Several pain treatment modalities have been developed apart from conventional parenteral opioids to provide superior analgesia. PCA is a system that is designed to accommodate the wide range of analgesic requirements that can be anticipated when managing acute pain. The major advantage with PCA therapy relates to the ability to minimize the time interval between the perception of pain and the administration of analgesic medication. Sustained pain relief due to constant drug concentration is achieved in PCA. Because of fluctuating blood drug concentrations in conventional IM therapy, the pain-related side-effects are more frequently seen.

Thomas et al (1995) found that PCA provides pain relief with a lower total dose of analgesic agent. In their study, patients receiving adequate control via IM therapy were given in the region of 30% more opioids than that of PCA.[6] Albert et al (1988), in a prospective randomised study of 62 patients undergoing colon surgery showed that PCA allows for analgesia with less sedation and less drug requirement than that of IM opioid administration.[2] However, Ferrante et al (1988), in their study of 40 patients did not find any difference in the quantity of morphine consumption between the IM and PCA groups.[3] The present study showed significantly less morphine consumption in the PCA group when compared to the IM group. An inadequate pain relief was noted in the IM group since 5 patients (17%) had to receive a supplementary dose of morphine.

Atwell et al (1984) in their comparative study of PCA and IM morphine found that there was a progressive decrease in opioid need and excellent pain relief in the PCA group.[4] Ferrante et al showed a trend of decreasing pain over time in the postoperative period in the PCA group.[3] In the present study, there was a decrease in pain scores with time in the postoperative period in both the groups. However, the decline in pain scores were greater in the PCA-treated group than the IM group and PCA group patients had better pain relief

Table 3: Comparison of pulmonary function parameters

		IM group Mean (95% CI)	PCA group Mean (95% CI)	*P* value
FEV 1 (litres)	Pre-operative	2.31 (2.13-2.49)	2.39 (2.21-2.57)	0.526
	Postoperative – 6 h	1.03 (0.93-1.13)	1.00 (0.80-1.14)	0.735
	Postoperative – 24 h	1.17 (1.03-1.31)	1.16 (1.00-1.32)	0.907
	Postoperative – 48 h	1.60 (1.46-1.74)	1.39 (1.21-1.57)	0.088
	Postoperative – 72 h	1.76 (1.64-1.88)	1.63 (1.45-1.81)	0.259
VC (litres)	Pre-operative	2.84 (2.56-3.12)	2.91 (2.67-3.15)	0.671
	Postoperative – 6 h	1.15 (1.01-1.29)	1.13 (0.99-1.27)	0.872
	Postoperative – 24 h	1.45 (1.31-1.59)	1.34 (1.20-1.48)	0.295
	Postoperative – 48 h	1.79 (1.61-1.97)	1.66 (1.44-1.88)	0.377
	Postoperative – 72 h	1.98 (1.88-2.08)	1.91 (1.65-2.17)	0.676
PEFR (litres/min)	Pre-operative	4.71 (4.13-5.29)	5.20 (4.46-5.94)	0.307
	Postoperative – 6 h	1.28 (1.09-1.47)	1.76 (1.46-2.06)	0.010
	Postoperative – 24 h	1.51 (1.35-1.67)	2.12 (1.82-2.42)	0.001
	Postoperative – 48 h	2.16 (1.90-2.42)	2.31 (2.01-2.61)	0.481
	Postoperative – 72 h	2.68 (2.36-3.00)	2.64 (2.34-2.94)	0.859

Degree of freedom- 60

IM- Intramuscular; PCA- Patient controlled analgesia; CI- Confidence interval;

FEV1- Forced expiratory volume in one second; VC- Vital capacity;

PEFR- Peak expiratory flow rate

probably due to the steady state of blood morphine concentration.

Wasylak et al (1990), in their comparative study showed that the reduction in vital capacity was similar in the IM and PCA groups and recovery occurred at the same time.[7] Camp JF (1991) showed better recovery of postoperative pulmonary functions in patients treated with PCA.[8] In the present study, overall pulmonary function parameters did not show significant difference at different intervals in the postoperative period between the IM and PCA groups. However, the PEFR showed better recovery in the PCA group during the first 24 hours.

Wheatley et al (1990) demonstrated decreased incidence of hypoxemia in PCA-treated patients compared to IM analgesia.[9] The incidence of life-threatening respiratory complications connected with the use of PCA has been reported to be 0.01%, similar to that seen with IM opioid or epidural morphine administration.[10] Ferrante et al found increased incidence of sedation in the IM group than the PCA group.[3] In the present study, there were no morphine-related complications like sedation, respiratory depression or hypoxemia in both the groups.

It can be concluded that patient controlled analgesia is a safe and effective method of pain management and is superior to conventional parenteral opioids for postoperative analgesia in patients undergoing abdominal operations. It provides better pain relief with less morphine consumption. The recovery of postoperative pulmonary function appears to be better in patients using PCA as shown by better early recovery of PEFR.

The main limitation of this study was a smaller study group and hence studies in a larger group of patients are needed for better assessment of pulmonary function derangements and morphine-associated complications.

REFERENCES

1. Craig DB. Postoperative recovery of pulmonary function. Anesth Analg 1981; 60:46-52.
2. Albert JM, Talbott TM. Patient controlled analgesia vs. conventional intramuscular analgesia following colon surgery. Dis Colon Rectum 1988;31:83-6.
3. Ferrante FM, Oray EJ, Rocco AG, Gallo J. Statistical model for pain in patient controlled analgesia and conventional intramuscular opioid regimens. Anesth Analg 1988;67:457-61.
4. Atwell JR, Flanigan RC, Bennett RL, Allen DC, Lucas BA, McRoberts JW. The efficacy of patient controlled analgesia in patients recovering from flank incisions. J Urol 1984;132:701-3.
5. Hedenstierna G. Mechanism of postoperative pulmonary dysfunction. Acta Chir Scand Suppl 1989;550:152-8.
6. Thomas V, Heath M, Rose D, Flory P. Psychological characteristics and the effectiveness of patient controlled analgesia. Br J Anaesth 1995;74:271-6.
7. Wasylak TJ, Abbott FV, English MJ, Jeans ME. Reduction of postoperative morbidity following patient controlled morphine. Can J Anaesth 1990;37:726-31.
8. Camp JF. Patient controlled analgesia. Am Fam Physician 1991;44:2145-50.
9. Wheatley RG, Shepherd D, Jackson IJ, Madej TH, Hunter D. Hypoxemia and pain relief after upper abdominal surgery: Comparison of i.m and patient controlled analgesia. Br J Anaesth 1992;69:558-61.
10. Ashburn MA, Love G, Pace NL. Respiratory related critical events with intravenous patient controlled analgesia. Clin J Pain 1994;10:52-6.