HYPOXAEMIA AND PAIN RELIEF AFTER LOWER ABDOMINAL SURGERY: COMPARISON OF EXTRADURAL AND PATIENT-CONTROLLED ANALGESIA

T. H. MADEJ, R. G. WHEATLEY, I. J. B. JACKSON AND D. HUNTER

SUMMARY

We have examined postoperative pain in patients allocated randomly to receive extradural bolus diamorphine 3.6 mg, extradural infusion of 0.15% bupivacaine with 0.01% diamorphine or patient-controlled i.v. administration of diamorphine at a maximum rate of 1 mg per 5 min, after total abdominal hysterectomy. Extradural infusion analgesia produced the smallest pain scores from 12 to 24 h after surgery (P < 0.05). More patients in the extradural infusion group were moderately hypoxaemic (Spo2 < 90% > 12 min h−1) after operation, compared with the two other groups (P < 0.05). The group using patient-controlled analgesia received more diamorphine and suffered a greater incidence of emetic sequelae (P < 0.05).

KEY WORDS


A recent report highlighted the inadequacy of pain relief after operation [1]. I.m. opioids given on an “as required” basis result in poor pain relief in up to 80% of patients [2], but newer techniques such as extradural opioids and patient-controlled analgesia may offer some advantages.

Ventilatory depression is a potentially life-threatening complication of any type of opioid analgesia. Pulse oximetry combined with computerized storage and analysis of data provides a method of continuously monitoring SpO2 at the patient’s bed side [3].

In a previous study comparing i.m., patient-controlled and extradural opioid analgesia, bolus extradural diamorphine was found to produce mild postoperative hypoxaemia for longer periods than the two other methods [4]. Extradural infusion of dilute local anaesthetic with opioid solutions is an alternative to bolus administration and has several potential advantages, including provision of a more constant level of analgesia, reduced opportunity for introducing infection and possibly a lesser incidence of respiratory depression by removing the bolus effect. In the present study, we have compared extradural bolus with extradural infusion and patient-controlled analgesia using a 5-min “lock-out”.

PATIENTS AND METHODS

The study was approved by the Hospital Ethics Committee. Written informed consent was obtained from 50 healthy patients undergoing total abdominal hysterectomy.

One hour before operation, patients received temazepam 30 mg orally. Anaesthesia was induced with propofol 2 mg kg−1, followed by vecuronium 0.1 mg kg−1 and IPPV with nitrous oxide and enflurane in oxygen. After induction of anaesthesia, a lumbar extradural block was produced with 0.5% bupivacaine 15–20 ml. The patients were allocated randomly, using a table of random numbers, to receive extradural or patient-controlled analgesia after operation.

Twenty patients (group EB) received an extradural bolus of diamorphine 3.6 mg in 0.9% saline 9 ml administered by the anaesthetist or senior nursing staff when requested by the patient. This was repeated as required during the first 24 h. Ten of these patients had participated in a previous study [4]. Twenty patients (group EI) received an extradural infusion of 0.15% bupivacaine with 0.01% diamorphine 4–6 ml h−1. Ten patients (group PCA5) self-administered i.v. diamorphine at a maximum rate of 1 mg every 5 min using a Graseby Patient Controlled Analgesia System. In each case, the total dose of diamorphine received in the first 24 h after operation was recorded.

Arterial oxygen saturation was monitored continuously during the preoperative night and for 24 h after operation, while the patient breathed air, using a Nellcor N-100 pulse oximeter interfaced with an Opus IBM-compatible microcomputer [3]. Recordings of SpO2 were made every 10 s and stored by the computer so that 360 samples were obtained every 1 h. The percentage time spent with SpO2 < 94% was defined as hypoxaemia as SpO2 < 94% for more than 20% of each epoch—that is 12 min h−1 [5]. Moderate hypoxaemia was defined as SpO2 < 90% for the same proportion of time and


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HYPOXAEOMIA AND POSTOPERATIVE PAIN RELIEF: I

TABLE I. Patient details and diamorphine use (mean (range)).

<table>
<thead>
<tr>
<th></th>
<th>Group PCA5 (n = 10)</th>
<th>Group EB (n = 20)</th>
<th>Group EI (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>40</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>(26-51)</td>
<td>(29-52)</td>
<td>(31-70)</td>
<td></td>
</tr>
<tr>
<td>Wht:ht* index (kg m⁻²)</td>
<td>26.5</td>
<td>25.0</td>
<td>27.0</td>
</tr>
<tr>
<td>(20-35)</td>
<td>(22-33)</td>
<td>(20-36)</td>
<td></td>
</tr>
<tr>
<td>Diamorphine (mg/24 h)</td>
<td>41***</td>
<td>14.5</td>
<td>10.5</td>
</tr>
<tr>
<td>(26-75)</td>
<td>(7.2-18)</td>
<td>(7.5-20)</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE II. Duration of hypoxaemia (min h⁻¹) (mean (95% confidence interval)) before and after operation in the three treatment groups.**

<table>
<thead>
<tr>
<th></th>
<th>Group PCA5 (n = 10)</th>
<th>Group EB (n = 20)</th>
<th>Group EI (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before op. &lt; 94%</td>
<td>0.67*</td>
<td>1.72*</td>
<td>8.82</td>
</tr>
<tr>
<td>(0.26-1.09)</td>
<td>(0-3.94)</td>
<td>(0-34.78)</td>
<td></td>
</tr>
<tr>
<td>After op. &lt; 94%</td>
<td>11.00</td>
<td>10.14*</td>
<td>22.00</td>
</tr>
<tr>
<td>(4.40-17.62)</td>
<td>(12.70-31.31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After op. &lt; 90%</td>
<td>1.42</td>
<td>1.28</td>
<td>6.67</td>
</tr>
<tr>
<td>(0.10-2.73)</td>
<td>(0.19-2.36)</td>
<td>(1.37-11.98)</td>
<td></td>
</tr>
</tbody>
</table>

Cigarette smokers in each group. Surgery and anaesthesia were uncomplicated in all 50 patients, with similar durations of operation and blood loss in the three groups. The amount of diamorphine used in the first 24 h by the patients in group PCA5 was significantly greater than that in the patients with extradural analgesia (P < 0.001) (table I).

Patients in group EI spent more time with Spₒ₂ < 94% before operation compared with the two other groups (P < 0.05). After operation, group EI spent more time with Spₒ₂ < 94% than did group EB (P < 0.05) (table II).

One patient in group EB and five in group EI were mildly hypoxaemic during preoperative monitoring of arterial oxygen saturation. After operation, nine of 20 EB, six of 20 EI and two of 10 PCA5 patients were mildly hypoxaemic. Five patients in group EI were moderately hypoxaemic after operation. Only one of these patients had been mildly hypoxaemic before operation; this patient was a non-obese, 51-yr-old smoker, who spent > 30% of the preoperative monitoring period with Spₒ₂ < 94%.

Analysis of episodes of moderate and severe hypoxaemia demonstrated that no patient spent more than 3 min with Spₒ₂ < 90% or more than 1.5 min with Spₒ₂ < 85% before operation. After operation, four patients in group EB spent periods of 7-90 min, seven patients in group EI spent 4-67 min and two patients in the PCA5 group spent 13-49 min with

RESULTS

The three treatment groups did not differ in age or degree of obesity. There were a similar number of

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**FIG. 1. Mean (SEM) visual analogue scale (VAS) pain scores 4-24 h after operation in groups PCA5 (△), EB (○) and EI (□).**

*P < 0.05 compared with groups EB and PCA5.
had been stratified for preoperative hypoxaemia. However, five patients in group E1 were moderately hypoxaemic before operation, but only one had been mildly hypoxaemic before operation. Moderate hypoxaemia was not seen in the other two groups. Pain relief was excellent in group E1 and this was most noticeable on the day after surgery when the patients started to mobilize. However, even with dilute infusions of local anaesthetic, the lumbar extradural restricted independent mobilization. One patient developed a deep venous thrombosis, another developed a pressure sore in legs lacking motor power, a third suffered weakness for several days after the extradural infusion was stopped and all patients were restricted further by routine urinary catheterization. We now limit extradural infusion analgesia after lower abdominal surgery to specific medical indications and complex surgery.

Group PCA5 demonstrated increased opioid use with increased availability. These patients, with a 5-min lockout, used 30% more than those in an earlier study with a 20-min lockout. However, this was still less than 12.5% of the maximum available. A short lockout is required if a background is not provided, so that patients can load themselves and “catch up” as necessary. We do not use background infusions because of evidence of hypoxaemia and detrimental increase in use [6, 7]. The bolus dose was double that of morphine 1 mg currently recommended, diamorphine having been shown to have double the potency of morphine in this situation [8, 9].

Patients in group PCA5 had small pain scores, although not as good as those in patients in group E1, and they increased to a peak at 16 h after operation. These patients underwent surgery in the afternoon and they became increasingly active at 16 h after operation during the morning after surgery. The visual analogue scores were recorded in both rest and active states, but in the same state for all groups at each time. Group PCA5 had a greater incidence of emetic sequelae than group E1 and also i.m. and PCA groups with a 20-min lockout. There are several possible explanations for this, including increased use of opioid, lack of routine prophylactic antiemetic medication and reluctance of nurses to administer and patients to request i.m. antiemetic medication [10].

Patients were very satisfied with this method of analgesia (despite the emesis) because of good pain relief, availability and control.

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REFERENCES

4. Wheatley RG, Somerville ID, Sapstorf DJ, Jones JG.
Postoperative hypoxaemia: comparison of extradural, i.m.
and patient-controlled opioid analgesia. *British Journal of

5. Entwistle MD, Roe PG, Sapsford DJ, Jones JG. Nocturnal
patterns of oxygen saturation following thoracotomy. *British

Pronounced episodic oxygen desaturation in the postoperative
period: its association with ventilatory pattern and analgesic

7. Owen H, Szekely SM, Plummer JL, Cushine JM, Mather
LE. Variables of patient-controlled analgesia 2. Concurrent

8. Owen H, Plummer JL, Armstrong I, Mather LE, Cousins
ML. Variables of patient-controlled analgesia 1. Bolus size.

9. Robinson SL, Rowbotham DJ, Smith G. Morphine com-

10. Semple P, Madej TH, Wheatley RG, Jackson IRB, Stevens J.
Transdermal hyoscine with patient controlled analgesia.
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