THE FIRST YEAR'S EXPERIENCE OF AN ACUTE PAIN SERVICE

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

SUMMARY

The benefits, risks and resource implications of providing an Acute Pain Service were assessed during the first year of the service. Six hundred and sixty patients recovering from major surgery were treated with patient-controlled analgesia (510 patients) or extradural infusion analgesia (150 patients). The results of a prospective outcome study showed that pain control was good: more than 60% of patients scored their pain as mild during the first 24 h. Only 10% of patients complained of severe postoperative pain. Eight patients developed potentially serious complications including respiratory depression and hypotension; the diagnosis and management of these problems on general wards is discussed. Retrospective analysis of the incidence of postoperative chest infection in surgical patients showed a marked reduction during the first year of the service (1.3% in 1988, 0.4% in 1989–90 (P < 0.01)).

KEY WORDS

Pain: postoperative, acute pain service.

"The treatment of pain after surgery in British Hospitals has been inadequate and has not advanced significantly for many years".

This opening statement from the Working Report [1] on Pain after Surgery of the Royal College of Surgeons and the College of Anaesthetists highlights the lack of progress in the provision of analgesia after major surgery.

The development of Acute Pain Services as described by Ready and colleagues [2] is an attempt to address this problem by the introduction of a multidisciplinary team to improve the management of acute pain throughout the hospital. The Acute Pain Service is responsible for the training of medical and nursing staff, organization of services to provide adequate levels of care, audit and evaluation of new and existing methods of treatment and undertaking clinical research into postoperative pain management.

Despite extensive experience in the U.S.A., there has been little development of Acute Pain Services in the U.K. because of manpower constraints [3] and recommendations have suggested that newer techniques should be restricted to High Dependency Units [4]. However, fewer than 30% of British Hospitals have a High Dependency Unit [5] and the restriction of complex methods of analgesia to these units would result in little improvement in the quality of pain relief for the majority of the surgical population.

It was decided, therefore, to evaluate outcome, including benefit, risks and resource implications, of providing an Acute Pain Service for general wards in a single site District General Hospital.

ACUTE PAIN SERVICE

The service which has been operating since April 1989 is based on the existing Obstetric Anaesthetic Service and is provided by three Consultant Anaesthetists, an Acute Pain Sister and the on-call obstetric anaesthetic junior staff. The service supervises the provision of acute pain relief throughout the surgical unit.

Methods of pain relief

Two standardized methods of pain relief are used:

Patient-controlled analgesia (PCA). A solution of morphine 50 mg in normal saline 50 ml was used in the PCA pumps. They were set to deliver a bolus dose of 1 mg with a lockout time of 5 min. No background infusions were used.

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Extradural infusion analgesia (EIA). A solution of 0.15% bupivacaine 50 ml with 5 mg of preservative-free diamorphine was infused at 4–8 ml h⁻¹. The dose of diamorphine was reduced to 2.5 mg/50 ml if the patient was older than 65 years of age.

Equipment

In the first year of the Acute Pain Service, the majority of patients receiving PCA were treated using Graseby PCAS pumps (Graseby Medical Ltd, Watford, Herts). Ten of these units were used. An additional three Bard PCA1 pumps (Bard Ltd, Crawley, W. Sussex) were used for the last 9 months. Extradural infusions were maintained using PCA pumps in the background infusion mode and Graseby MS2000 syringe drivers.

Criteria for admission to and discharge from the service

Any patient requiring opioid analgesia for the relief of postoperative pain or any acutely painful condition (e.g. pancreatitis or fractured ribs) was eligible for admission to the service. The analgesic techniques (PCA and EIA) were continued until the patient was comfortable or able to take oral analgesia.

Organization

These techniques were used by all members of the Anaesthetic Department (10 Consultants, nine Trainees and one Clinical Assistant) for patients undergoing major surgery. The method of analgesia was explained to the patient at the preoperative visit. When EIA was chosen, the extradural was sited where possible at the dermatomal midpoint of the proposed incision and used for peroperative analgesia. The postoperative treatment regimen was initiated by the nursing staff under the direct supervision of the anaesthetist in the recovery room immediately after surgery.

Before the introduction of the service to each ward, staff were given demonstrations of the equipment, and tutorials about the techniques and monitoring requirements were given by members of the Acute Pain Team. An explanatory document about the service and the techniques used was provided to each ward. In order to minimize the risks to patients nursed on general wards, several recommendations were made:

1. Patients were sent only to those wards where the Acute Pain Team deemed there were adequate numbers of trained staff.
2. Standardized treatment regimens were used for both PCA and EIA.
3. The introduction of written procedures and In-Service Training was the responsibility of the Acute Pain Sister.
4. There was 24-h availability of a named anaesthetist with designated Consultant cover.
5. Facility for continuous oximetry and transfer to ITU for high risk patients was available.
6. Continuous oxygen therapy via nasal cannulae was administered to high risk patients for 2–3 days.

Nursing observations. Recovery staff recorded the patient's ventilatory frequency, pain score and, in the case of EIA, the dermatomal level of the block (tested by loss of temperature sensation) at 15-min intervals. On the patient's return to the ward, these observations were continued at 1-h intervals for the first 4 h and then 4-hourly if the patient's condition was satisfactory. Details of the volume of analgesic infused and the condition of the i.v. site were also recorded. The pain score (table I) was a simple nurse assessment of the patient's degree of pain at rest and on movement [Prys-Roberts, personal communication].

<table>
<thead>
<tr>
<th>Score 0 = No pain at rest</th>
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<tbody>
<tr>
<td>No pain on movement</td>
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<tr>
<td>Score 1 = No pain at rest</td>
</tr>
<tr>
<td>Slight pain on movement</td>
</tr>
<tr>
<td>Score 2 = Intermittent pain at rest</td>
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<tr>
<td>Moderate pain on movement</td>
</tr>
<tr>
<td>Score 3 = Continuous pain at rest</td>
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<tr>
<td>Severe pain on movement</td>
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</tbody>
</table>

Ward rounds. Following referral to the Acute Pain Service, patients were assessed at regular ward rounds by the Acute Pain Team. During these visits at 24 h and 48 h after surgery, a record was made of the patient's assessment of pain (visual analogue score 0–10), the incidence of nausea and vomiting and degree of patient satisfaction with the technique. I.m. antiemetics were prescribed on an "as-required" basis.

Pain assessment. The nurse and patient scoring of pain were compared by grading each as mild,
ACUTE PAIN SERVICE

TABLE II. Gradation of pain scoring. Nurse score = first six 4-hourly scores; patient = VAS 0–10

<table>
<thead>
<tr>
<th>Nurse</th>
<th>Patient</th>
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<tbody>
<tr>
<td>Mild</td>
<td>0–6</td>
</tr>
<tr>
<td>Moderate</td>
<td>7–12</td>
</tr>
<tr>
<td>Severe</td>
<td>13–18</td>
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</table>

moderate or severe (table II). The nurse score was obtained by summation of the first six 4-hourly pain scores on the ward. The patient score was a single VAS (0–10) at 24 h. All results were assessed using the unpaired t test, Welch’s test or, for non-parametric data, chi-square test.

Retrospective study

The results of the regular Review of Nosocomial Infection in the Surgical Unit were analysed retrospectively. The diagnosis of lower respiratory tract infection was made by the Infection Control Officer on the basis of the Atlanta criteria [6] of fever, cough and purulent sputum.

Audit of workload

Audit of the working pattern of the Consultant and Trainee anaesthetists involved was undertaken over a 2-month period.

RESULTS

Patient data

The Acute Pain Service supervised 660 patients on 18 general wards in the first year (table III). PCA was used three times more frequently than EIA. The mean age of patients receiving PCA was significantly less than that of those having EIA, and male patients were significantly older than female patients ($P < 0.01$). The overall age range of patients was 12–92 yr. The mean duration of treatment was 55.5 h for both PCA and EIA (range 1–207 h). The PCA group received morphine 2–200 mg in the first 24 h. Female patients used significantly smaller doses of morphine than male patients in the first 24 h ($P < 0.005$) and the duration of their treatment was shorter ($P < 0.0001$).

TABLE III. Patient details (mean (SD or range))

<table>
<thead>
<tr>
<th></th>
<th>PCA</th>
<th>EIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>No. of patients</td>
<td>363</td>
<td>147</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>48 (14–88)</td>
<td>59 (18–89)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65 (13)</td>
<td>73 (14)</td>
</tr>
<tr>
<td>Dose of opioid (mg/24 h)</td>
<td>43 (21)</td>
<td>49 (31)</td>
</tr>
<tr>
<td>Duration of treatment (h)</td>
<td>50 (1–144)</td>
<td>61 (4–190)</td>
</tr>
</tbody>
</table>

Fig. 1. Referral pattern. □ = PCA; □ = EIA. Gen. = General surgery; Gynae. = gynaecological surgery; GU = genito-urinary surgery; Ortho. = orthopaedic surgery.
patients experienced mild pain during the first 24 h, with only 7% of patients receiving EIA and 11% receiving PCA complaining of severe pain. The mean patient scores for the first 24 h were low for both treatment groups (mean VAS: PCA 3.5; EIA 2.2). Patients receiving EIA were more likely to have no pain or mild pain than those with PCA (chi-square, \( P < 0.05 \)); however, a greater proportion of patients with PCA were satisfied with their method of analgesia (chi-square, \( P < 0.05 \)).

**Complications**

*Emetic sequelae* were common with PCA and EIA (table V). Vomiting was twice as common in female patients compared with male patients and more frequent after gynaecological surgery (chi-square, \( P < 0.01 \)). The incidence of nausea and vomiting was not related to the dose of opioid.

*Urinary retention* after EIA could not be assessed because the majority of patients receiving this form of analgesia routinely underwent catheterization.

*Respiratory depression.* The mean slowest ventilatory frequency recorded for both PCA and EIA was 15 b.p.m. (range 6–20 b.p.m.). Ten patients in the PCA group and three in the EIA group had ventilatory frequencies of less than 10 b.p.m., but had no other clinical evidence of respiratory depression. Four patients receiving PCA and one patient in the EIA group had airway obstruction associated with oversedation requiring the use of i.v. naloxone. Three of these patients had a ventilatory frequency less than 10 b.p.m., but the remaining two patients had frequencies in the normal range.

*Hypotension* secondary to relative hypovolaemia in the early postoperative period was a problem in the EIA group. The 8th thoracic dermatome was the mean maximum height of sensory block, (range T2–12). The mean smallest systolic arterial pressure with EIA was 100 mm Hg (range 60–140 mm Hg).

*Prolonged unilateral motor block* lasting 4–10 days and which delayed mobilization occurred in two patients recovering from lower abdominal surgery receiving EIA via a lumbar extradural catheter.

**Referral pattern**

The majority of patients were referred to the service after abdominal general or gynaecological surgery (fig. 1). Non-surgical referrals included patients with fractured ribs, acute back pain, pancreatitis and extra-amniotic termination of pregnancy.

Figure 2 illustrates the type of analgesia used and the ASA grading of patients: patients receiving PCA were more commonly ASA I or II, whereas a greater proportion of patients with EIA were ASA III or IV (\( P < 0.01 \)).

**Pain scores and patient satisfaction**

Nursing and patient assessment of pain were broadly in agreement (table IV). The majority of

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**TABLE IV. Pain assessment and patient satisfaction**

<table>
<thead>
<tr>
<th></th>
<th>PCA</th>
<th>EIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patient</td>
<td>Nurse</td>
</tr>
<tr>
<td>Pain assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild (%)</td>
<td>63</td>
<td>73</td>
</tr>
<tr>
<td>Moderate (%)</td>
<td>26</td>
<td>17</td>
</tr>
<tr>
<td>Severe (%)</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Satisfied (%)</td>
<td>.</td>
<td>96</td>
</tr>
</tbody>
</table>

**TABLE V. Emetic sequelae (% or mean (SD))**

<table>
<thead>
<tr>
<th></th>
<th>PCA</th>
<th>EIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Vomiting (%)</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>Nausea (%)</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Dose of opioid (mg/24 h)</td>
<td>44 (20)</td>
<td>51 (30)</td>
</tr>
</tbody>
</table>
Incidence of lower respiratory tract infections. The review of the Nosocomial Infection Surveillance showed that the incidence of lower respiratory tract infection in postoperative general surgical patients was significantly reduced in the first year of the Acute Pain Service (1.3% of 4290 discharges in 1988; 0.4% of 4667 in 1989-90 (P < 0.01)).

Audit of workload
Approximately 30% of each Consultant session was spent on the ward rounds and work related to the provision of the service. The Trainee anaesthetist spent 26% of his working time on acute pain work.

DISCUSSION
The major questions in the provision of Acute Pain Services relate to efficacy, safety and the use of limited resources.

Efficacy
The use of a single recording of the VAS at 24 h has been shown [7] to be a reasonable reflection of the patient’s pain after surgery and correlates well in this study with the nurse scoring system used. Overall pain control in the two treatment groups was satisfactory, with more than 60% of patients scoring their pain as mild during the first 24 h. The majority of patients treated were recovering from major abdominal surgery. Major orthopaedic and urology cases were referred less frequently as surgery tended to be performed under spinal anaesthesia, with postoperative non-steroidal anti-inflammatory analgesia.

Patients receiving i.m. analgesia were not studied, but two recent studies have highlighted the shortcomings of conventional i.m. analgesia. Kuhn and colleagues [8], in a study of a similar surgical population undergoing abdominal surgery, found that only 13% of patients had little or no pain (mean VAS of all patients in the study during the first 24 h = 6.0). In a study of patient’s expectations, Owen, McMillan and Rogowski [9] found that only 26% of patients scored their pain as mild or absent.

A further measure of efficacy of analgesia is the patient’s ability to cough well and co-operate with physiotherapy. Although these factors were not part of the prospective study, retrospective analysis of Microbiology records provided evidence that the incidence of chest infections decreased during the first year of the Acute Pain Service. Although a causal relationship cannot be established, there were no other major changes in caseload, antibiotic therapy, surgical or ward practice to account for the reduction in chest infection.

EIA was used in a significantly older population with a higher incidence of pre-existing disease (ASA III-IV) undergoing more major surgery. This reflected our tendency to reserve the technique for high risk patients and those unable to use PCA. EIA was associated with good analgesia, with less than 7% of patients experiencing severe postoperative pain. Although the level of patient satisfaction was high, it was less than in those receiving PCA, probably because of lack of patient control, reduced mobility, urinary retention and technical failures secondary to the sitting of the catheter or equipment malfunction.

Safety
During the first year of the Acute Pain Service, eight of the 660 patients treated (1.2%) developed potentially serious complications. Of the 510 patients receiving PCA, four patients had respiratory depression which required treatment with i.v. naloxone. Two of these patients had received concomitant analgesic therapy (opioid or NSAID) and two poorly selected elderly patients were too sleepy to use the device and received nurse-controlled analgesia. Three of the four problem patients occurred in the first 100 PCA patients and only one patient in the subsequent 450 patients gave cause for concern.

In the EIA group of patients (150), only one developed ventilatory problems, which were secondary to excessive sedation, airway obstruction and hypovolaemia. Two patients with lumbar extradural catheters complained of prolonged weakness of one leg, resulting in marked reduction in mobility. One of these patients developed deep venous thrombosis, despite the continuous extradural infusion of local anaesthetic.

The major concern in the extradural group was development of relative hypovolaemia 4–16 h after operation, secondary to inadequate fluid replacement and the sympathetic block caused by extradural bupivacaine. In one 70-yr-old male recovering from an abdomino-perineal resection, postoperative haemorrhage was inadequately treated as the hypotension was attributed incorrectly to the effects of the extradural block. The patient subsequently suffered a myocardial infarction and died. The incidence of hypotension
decreased as anaesthetic and surgical staff became aware of this problem and paid particular attention to postoperative fluid replacement and the use of colloid solution with a longer half-life.

In addition, experience from the first 200 patients confirmed Ready's observation that over-sedation is a valuable clinical sign of impending respiratory depression. A simple sedation score has now been added to the routine postoperative observations.

Resource implications

Staffing. The Acute Pain Service as described, based on the existing obstetric anaesthetic services, did not involve additional staff other than the key appointment of an Acute Pain Sister. However, in a multiple-site District General Hospital or in an obstetric unit without adequate Consultant cover, additional sessions would have to be made available. The extent of the sessional commitment would obviously depend on the size of the service and the number of patients treated. A substantial part of the time spent by the Trainee anaesthetist was refilling and attending to problems with the PCA pumps. This proportion should decrease with the increasing involvement of the nursing staff, as a consequence of the inclusion of refilling PCA pumps in the extended role of the nurse.

Equipment. The PCA pumps proved to be robust and reliable [10]. The major complaint of nurses, surgeons and anaesthetists about the pumps was their lack of availability. The number of pumps was increased from six to 15 in the first year. At approximately £2000 each they are expensive, but their cost can be offset against reduced nursing time checking i.m. analgesia and the reduced cost of treating fewer chest infections.

Initially, EIA was provided by using the standard PCA pump in the background infusion mode. This pump required refilling twice a day and there is the potential for confusion between patients receiving PCA and EIA. To minimize this risk, EIA is now provided using an ambulatory PCA device (Bard Ltd) which uses a 250-ml infusion bag. These bags are prepared by pharmacy and usually provide analgesia for a little more than 2 days without refilling.

Support services. It was apparent from the outset of the service that refilling 10–15 pumps in a variety of surgical locations in a safe manner posed major problems. The use of standardized regimens for PCA and EIA and the active involvement of the Pharmacy Department resulted in the batch preparation of 50-ml syringes which are frozen and stored in the pharmacy. Supplies of these syringes and the 250-ml infusion bags for EIA are stocked in the recovery area for starting patient treatment. Ward staff automatically order a prefilled syringe or bag when a patient returns to the ward with a PCA or EIA pump.

Similarly, the involvement of the physiotherapy staff has increased during the development of the service. Physiotherapists now join the ward round and their assessment of the adequacy of analgesia and the patient's ability to cough is extremely valuable. In addition, they act as a source of secondary referrals to the Acute Pain Service when they encounter a postoperative patient with conventional analgesia who is unable to co-operate with physiotherapy.

CONCLUSION

The experience of the first year of an Acute Pain Service has demonstrated that the adoption of a multidisciplinary team approach may lead to a marked improvement in postoperative pain relief. Although attention has tended to focus on the patients receiving relatively sophisticated methods of analgesia, the change in attitude of surgeons, anaesthetists and nursing staff involved with the service has resulted in more attention being paid to all patients recovering from surgery. This has been demonstrated by the increased use of regional techniques in theatre, the use of i.v. opioids by recovery staff and the use of NSAID in the perioperative period. Regular ward rounds have been accepted readily as a major improvement over previous ad hoc arrangements and this daily audit of the service and feedback to anaesthetic and surgical colleagues has led to the delivery of a more consistent standard of postoperative care.

REFERENCES