Introducing a patient-controlled analgesia-based acute pain relief service into southern Africa — the first 10 months

E. A. SHIPTON, A. G. BEETON, H. S. MINKOWITZ

Abstract **The 10 months after the introduction of the first acute pain relief service (APRS) in southern Africa is described. Seven hundred patients were treated with morphine by means of patient-controlled analgesia (PCA), administered to patients after major surgery or extensive burns via the intravenous (IV) or subcutaneous (SC) route. The efficacy, safety and resource implications were assessed. The results showed that pain control was good, with the majority of patients (66%) experiencing mild pain during the first 24 hours. The pump was used by each patient for an average of 4,32 days. The mean total dose of morphine used was 105,2 mg via the IV route and 114,6 mg via the SC route. Over the 10 months, the 25 PCA pumps worked 80 000 pump-hours; only 3 pumps malfunctioned. A total of 86 861 mg morphine was used during this period with rare morbidity and no mortality. Only 1 patient experienced sedation and respiratory depression. The benefits of an APRS with PCA to patients and medical staff alike are discussed.**

S Afr Med J 1993; **83:** 501-504.

A recent editorial stated: 'A visit to most postoperative wards will show you the time-honoured ritual of inadequate postoperative pain management. Patients expect ineffective pain relief, and their carers ensure that they are not disappointed.'[1] The recent Working Party Report of the Royal College of Surgeons and the College of Anaesthetists[2] had this to say: 'The treatment of pain after surgery in British hospitals has been inadequate and has not advanced significantly for many years. In the 1980s, surveys of patients' subjective well-being revealed an incidence of moderate or severe pain after surgery of 30-75%.'[3]

The development of acute pain relief services (APRSs) is an attempt to address this problem. Acute pain relief teams operating an APRS have been established in the USA and the UK.[4] The first APRS in southern Africa was established at Hillbrow Hospital in May 1991 under the auspices of the Department of Anaesthesiology.[5]

The aim of this paper is to describe the introduction of this service, and to evaluate the resource implications of providing such a service in an academic teaching hospital.

Department of Anaesthesia, Hillbrow Hospital, and University of the Witwatersrand, Johannesburg
E. A. SHIPTON, M.B CH. B., D.A., M. MED., F.F.A., M.D.
A. G. BEETON, M.B. B.CH., D.A., F.F.A.
H. S. MINKOWITZ, M.B. B.CH., DIP. DATA

Accepted 2 Nov 1992.

Methods

Equipment

Patients receiving PCA are treated using a computed ambulatory drug delivery-patient controlled analgesia (CADD-PCA) ambulatory infusion device (Pharmacia Deltic, St Paul, Minnesota). Twenty-five of these pumps were acquired at the outset. The cost of each pump was R10 000. Pumps are in action on a virtually continual basis with demand usually exceeding supply.

PCA technique

The ARPS initially used morphine 2 mg/ml made up to 50 ml with water in the PCA pumps; this was administered via the intravenous (IV) route. The pumps were set to deliver an on-demand bolus dose of 1 mg morphine. The lock-out time was orginally set at 10 minutes but, after a few months, was reduced to 6 minutes. A background infusion of morphine (1 mg/h) was used routinely. A dedicated IV line was reserved for the PCA infusion.

After 12 weeks, it was decided to try the subcutaneous (SC) route of administration. A 21-gauge winged infusion device was inserted into the SC tissue of the anterior abdominal wall. The site was later changed to the SC tissue overlying the deltoid muscle. The insertion site was covered with a sterile, transparent adhesive dressing. A more concentrated solution of morphine 4 mg/ml made up to 37,5 ml with water was used for the SC route, although the remaining administration parameters remained identical to those of the IV route.

Provisional planning

Management of pain often becomes everybody's problem but nobody's responsibility. The organisation of the APRS is the responsibility of the Professor of Anaesthesiology, who acts as co-ordinator, so that an efficient, structured service can be delivered to all inpatients. It soon became evident that senior registrars would be needed to co-ordinate the day-to-day running of the service and consult on acute pain problems within the hospital; they would also have the skill necessary to assess which patients would benefit most from the limited number of PCA devices available to the APRS.

Organisation

Senior registrars are assigned to share the service load. This enables the service to be offered 24 hours a day with designated consultant cover. The registrars carry radio receivers for quick access.

The registrars' role is multifaceted. They are responsible for the maintenance and filling of the pumps, and for carrying out a daily ward round to assess the patients on PCA devices. They also offer a daily pain relief service where pain problems are assessed and managed. Pain care in the paraplegic ward is almost exclusively the

responsibility of the APRS. The registrars are actively committed to conducting ongoing research into acute pain. This multifaceted role is important, given the expense of having a full-time registrar committed to the APRS. The registrars are chosen for their special interest in pain management, and are thus dedicated to their task.

Before the introduction of the service to each ward, staff were given demonstrations of the equipment and tutored as to the monitoring requirements. The immediate availability of skilled help from the members of the APRS, day or night, was emphasised. After 8 months, a full-time APRS nursing sister joined the team. She systematically began tutoring the nursing staff ward by ward about the service, and advised on any problems that had been encountered.

Criteria for admission to the APRS

Any patient requiring opioid analgesia for the relief of postoperative pain or any acutely painful conditions (e.g. pancreatitis, fractured ribs, burns) received the attention of the APRS. However, because of the limited number of pumps, not all patients in severe acute pain could be treated with PCA. Patients were thus chosen to receive PCA pumps on the basis of availability, preoperative assessment by the APRS, or on request from the anaesthetist or surgeon in theatre. PCA with morphine was not used in patients allergic to morphine, and in patients physically unable to operate the pumps (e.g. those who were unconscious, confused or elderly).

Referral pattern

The majority of patients were referred to the service after general surgical procedures (Fig. 1). Other referrals included orthopaedic and ENT patients, patients with burns and patients from intensive care. Patients were also treated for acute non-operative pain (such as pancreatitis, multiple secondaries).

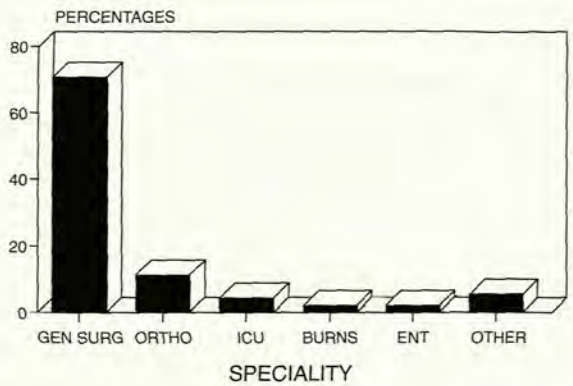

FIG. 1.
Breakdown of patient-controlled analgesia usage per specialty (expressed as a percentage) (GEN SURG = general surgery; ORTHO = orthopaedics; ICU = intensive care unit; ENT = ear, nose and throat).

Pain score

Various pain scoring methods have been used during the evolution of the service in order to find one suitable for our patient population. We have eventually settled on a modified linear visual analogue pain scale (VAS) (Table I).

TABLE I.
Interpretation of the modified linear VAS for patient explanation purposes

0	No pain
1	Mild pain on normal exertion
2	Mild pain on coughing/movement
3	Mild pain at rest
4	Moderate pain on normal exertion
5	Moderate pain on coughing/movement
6	Moderate pain at rest
7	Severe pain on normal exertion
8	Severe pain on coughing/movement
9	Severe pain at rest
10	Worst pain imaginable

Before surgery

All patients scheduled for major elective surgery are seen in the ward by the APRS nursing sister. She explains to them what type of pain relief they should expect, and shows them how to use the PCA pump. Any questions from the patients are answered. The patients are also visited by the anaesthetist for pre-operative assessment.

Intra-operative

Patients receiving regional analgesia as the sole anaesthetic technique or as a component of a general anaesthetic, have their PCA pump background infusion started by the anaesthetist in theatre before discharge to the recovery room. Patients not receiving regional analgesia are given a loading dose in addition to the background infusion before discharge to the recovery room. In the recovery room further doses are given, if necessary, to achieve a comfortable level of analgesia.

Immediate postoperative care

Within 4 hours after surgery the patients are seen in the ward by the on-call anaesthetic registrar and the APRS sister. If needed, further bolus doses are administered and/or the background infusion adjusted.

Patients with burns

Many of our patients with extensive burns receive PCA pumps. Patients administer bolus doses before the changing of their dressings and before other ward procedures. Shortened lock-out periods (4 - 6 minutes) allow more rapid achievement of the desired level of analgesia before the procedure. Most patients with extensive burns require prolonged PCA therapy. Background infusions are, however, usually discontinued after 2 - 3 days.

Follow-up

Each morning the anaesthetic registrar and the APRS sister undertake a postoperative round. An assessment is made of each patient, and the database form is filled in. We have adopted a three-step regimen for weaning patients off PCA. The regimen assumes that satisfactory pain scores have been obtained at each stage: (*i*) the initial background infusion of morphine I mg/h is halved when the on-demand morphine usage falls below approximately 20 mg for the previous 24 hours; (*ii*) the background infusion is stopped once the patient requires less than 20 mg morphine over and above a 0,5 mg/h background infusion of morphine; and (*iii*) PCA is stopped once the patient's total morphine consumption in the previous 24 hours is less than 20 mg.

Nursing observations

Pulse, blood pressure, respiratory rate, and sedation were observed at hourly intervals for the first 4 hours postoperatively after the patient's return to the ward, and then 4-hourly if the patient's condition was satisfactory. No specific additional monitoring was required by the APRS. Troubleshooting instructions for the management of excessive sedation or unrelieved pain were, however, attached to the treatment chart of each patient.

Pain is assessed by the patient during the daily ward round on a score of 0-10 (Table I). The pain score is recorded by the APRS registrar on the database form.

Results

Patient data

The APRS supervised 700 patients in general surgical wards, orthopaedic wards, the ICU and the burns unit during the first 10 months. Two hundred and thirty-two women and 468 men were treated. The overall age range of patients was 14 - 86 (mean 39,9 ± 15,26) years. The mean duration of treatment was 4,29 (± 2,95) days (Table II). Three hundred and ninety-nine patients had laparotomies (Table III). Three hundred and twenty-three patients were treated after emergency surgery and 377 after elective surgery. Two hundred and forty-eight patients were treated via the IV route and 452 patients via the SC route. The mean total dose of morphine used was 105,2 mg via the IV route and 114,6 mg via the SC route.

TABLE II.
Pattern of morphine consumption in patients on SC and IV PCA

	Subcutaneous	Intravenous
Total	452	248
Male	315	153
Female	137	95
Mean age	39,02	41,76
Days of PCA	4,26	4,37
Elective	238	139
Emergency	214	109
Mean total dose (mg)	114,6	105,2
Background infusion (as % of total dose)	33,6	32,8

TABLE III.
Pattern of the surgical incisions in patients receiving SC and IV PCA morphine

	Subcutaneous	Intravenous
Head and neck	17	5
Sternotomy	23	10
Thoracotomy	8	5
Spinal	7	7
Subcostal	6	8
Laparotomy	241	126
Supra-umbilical lap.	7	7
Sub-umbilical lap.	5	13
Pfannenstiel	1	1
Retroperitoneal	4	2
Peripheral	82	47
Multiple procedures	4	0
Non-operative pain	12	3
Chronic pain	7	6
Burns	10	8

Patient score

The majority of patients experienced mild pain (Fig. 2). Both IV and SC groups reported similar levels of postoperative analgesia. Thus overall pain control was satisfactory (Fig. 2).

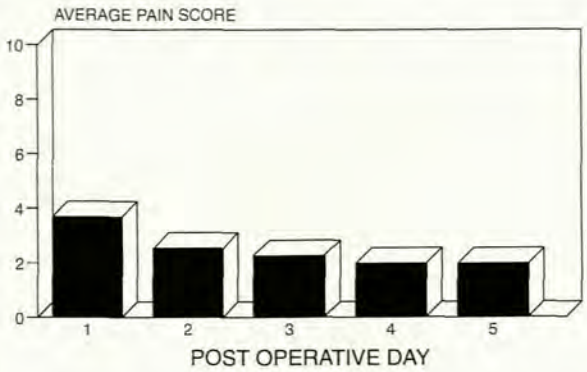

FIG. 2.
Bar graph showing the average daily pain scores (out of 10) over the first 5 postoperative days.

Complications

Localised swelling and induration at the SC infusion site occurred in 20 patients. The SC site was then switched or the patient placed on a combination of oral analgesics (paracetamol, codeine) and oral anti-inflammatories (ibuprofen, indomethacin) and the PCA discontinued. Localised SC abscesses occurred in 4 patients. Vomiting only occurred in 10 patients. This is in keeping with the low incidence of opioid-induced nausea which, surprisingly, we have found in our black patients. A throbbing bitemporal headache was noted in 31 patients. Even more interesting was that only 1 patient experienced sedation and respiratory depression (respiratory rate < 8/min). A concomitant pathological respiratory condition contributed to this patient's clinical picture. This patient was treated with IV naloxone, which produced a transient clinical improvement. The patient subsequently required short-term ventilation, diuretics and antibiotics to treat the respiratory condition.

Discussion

The major questions in the provision of APRS relate to efficacy, safety and the use of resources.

Efficacy

The use of a single recording of the VAS at 24 hours has been shown to be a reasonable reflection of a patient's pain after surgery.[6] Overall pain control was satisfactory (Fig. 2). A further measure of the efficacy of analgesia is the patient's ability to cough well and co-operate with physiotherapy. Patients or physiotherapists often administer bolus doses just before physiotherapy is started. The physiotherapists are active supporters of the APRS.

Safety

During the first 10 months of the APRS, only 1 of the 700 patients treated developed sedation and respiratory depression (with the patient's respiratory condition a

contributory cause). Oversedation is a valuable clinical sign of impending respiratory depression. We have added a simple sedation score to the routine observations made. This is done in order to ensure that oversedation is not missed.

One patient died while receiving PCA therapy. PCA morphine was not, however, implicated as a contributory factor in the patient's death as the patient had a massive pulmonary embolus.

Staffing

In order to operate the service 24 hours a day and 7 days a week, two rotating senior registrars are required. Each senior registrar is on duty for a week at a time and weekends are shared. Senior registrars are needed to provide adequate skill and experience. Other senior registrars are also trained to serve in the APRS should one of the registrars fall ill or take leave. Consultant cover is provided by the anaesthetic consultant on call for each 24-hour period.

The filling and checking of the pumps take a great deal of the senior registrar's time. Ten ampoules of morphine have to be opened to fill each pump.

The key appointment of an APRS nursing sister has made a great difference to the service. She checks the patients pre-operatively, explains to them the use of PCA pumps and obtains their informed consent. She helps the senior registrar to prepare and put up the pumps. She attends the main morning ward round with the senior registrar where pumps are adjusted and refilled, and data collected. She is reponsible for the logistics of the APRS. Most valuable is the in-service education that she provides to ward staff. She carries a radio receiver and can be contacted to advise on any problems associated with the service.

Equipment

The PCA pumps have proved robust and reliable. Over 10 months the 25 pumps have worked 80 000 pump-hours or 3 200 hours each. Only 3 pumps have malfunctioned during this period. The pumps were not recording doses given and stored data were lost. The pumps were immediately replaced with new ones by the supplier.

The specific disposable 50 ml cassettes for the CADD-PCA pump are imported from the USA and are expensive (R40 each). They are time-consuming to fill, which is where a syringe pump PCA (e.g. Graseby) may have a distinct advantage. Fortunately, the extension sets can be manufactured locally.

The advantage of this battery-driven pump is that it allows ambulation. The disadvantage is that battery failure can occur, which may lead to break-through pain. Long-lasting alkaline batteries are essential.

A locking code prevents the patient from changing the preset pump parameters. However, the pump may be switched off accidentally if the patient presses on it (e.g. during sleep). The original extension sets had clamps. These sets were occasionally clamped by the nursing staff, triggering the blockage alarm on the PCA pump. Extension sets without clamps are now used.

Because of poor IV line care in the wards, necessitating frequent changes of the dedicated PCA IV line, it was decided to try the SC route. This is quick, simple to manage, and easy to change, if necessary.

Morphine was chosen because it is efficacious and cheap. The average cost of morphine usage with the PCA pump is R0,78 per patient per day. The initial lock-out time was changed from 10 minutes to 6 minutes as occasional break-through pain occurred especially on the 1st postoperative day. The 80 000 pump hours worked and the total 86 861 mg of morphine consumed over 10 months with rare morbidity and no mortality testify to the safety of this technique in the ward situation.

The change to the SC route proved justifiable as no increases in the total opioid dose, the number of demands made for analgesia or the duration of the analgesic therapy were found (Table II). The SC line was easily relocated in the 20 patients who developed localised induration. This localised induration was most often seen after more than 4 days of PCA therapy. The efficacy and simplicity of the SC route means that the APRS at Hillbrow Hospital now uses this route routinely for the administration of all PCA therapy.

Delay in weaning from the PCA pump often alerts the anaesthetist to the possibility of surgical complications (e.g. sepsis, infarcted bowel), that the patient may be a chronic opioid user, or that absorption from the SC site is not optimal. Because the pump allows ambulation, occasionally a patient walks around the hospital and cannot be found at the time of the daily ward round.

Advantages

In introducing the APRS, we were fortunate enough to enjoy the co-operation of all members of the Anaesthetic Department at Hillbrow Hospital. Because it is the first of its kind in southern Africa anaesthetists may have been that much more determined to ensure its success. Resistance to the introduction of such a service from our surgical colleagues was anticipated. However, from the beginning they were all most co-operative and are now quite happy that the Anaesthetic Department manages the postoperative pain of all their major surgical cases. They do, however, complain when no pumps are available! It is planned in future to extend the service to the gynaecologists, when 10 more PCA pumps which have been ordered come into service.

Initial resistance from the nursing staff was encountered during the introduction of the service, mainly because of ignorance of what it would entail. However, this attitude has changed to one of full co-operation in view of the patient benefits and the saving of nursing time and stress. Having a nursing sister as a member of the APRS has enhanced the involvement and status of the nursing staff in this new service. As one surgical colleague remarked: 'The nurses are your biggest fans!'

The Department of Physiotherapy has been most co-operative as the patients have much less discomfort during physiotherapy, exercise much better and walk again earlier.

Not only surgeons, but nurses, physiotherapists and occupational therapists draw the attention of the APRS to patients they think need our help.

The presence of anaesthetists at postoperative ward rounds has had an indirect beneficial effect in showing the anaesthetist fulfilling a more clinical role. It also raises the importance of pain prevention in the minds of all clinical staff, and has raised the standard of postoperative care.

Patients have benefited enormously from the service, not only from the more effective analgesia given, but also from their heightened sense of autonomy and decreased frustration. Patients are now examined more frequently and occasional complications are picked up by the APRS (e.g. hypovolaemia).

Effective analgesia and earlier ambulation should lead to decreased postoperative morbidity. We are at present looking at the incidence of postoperative chest

infections and deep venous thrombosis after the use of PCA. The cost-benefit ratio and decrease in length of hospital stay are also being studied. Undoubtedly one of the most humane uses of PCA has been in burns patients, especially those undergoing daily dressing changes.

The APRS has embarked on an active teaching programme for undergraduate and postgraduate medical and nursing staff alike. The research potential of the service has also been realised, and various trials are presently being conducted in different areas of acute pain relief. This year we will expand the use of the PCA pumps to include the epidural route in the ward situation.

These are still early days as we slowly expand our service, and gain knowledge and clinical expertise — but the experience of introducing an APRS into southern Africa over the past 10 months has been a very positive one.

REFERENCES

1. Harmer M. Postoperative pain relief — time to take our heads out of the sand? *Anaesthesia* 1991; **46:** 167-168.
2. Royal College of Surgeons of England and College of Anaesthetists. Commission on the provision of surgical services. Report of the Working Party on Pain after Surgery, 1990.
3. Cartwright PD, Helfinger RG, Howell JI, Siepmann KK. Introducing an acute pain service. *Anaesthesia* 1991; **46:** 188-191.
4. Wheatley RG, Madej TH, Jackson IJB, Hunter D. The first year's experience of an acute pain service. *Br J Anaesth* 1991; **67:** 353-359.
5. Upton PM, Beeton AG, Minkowitz HS, Shipton EA. Patient-controlled analgesia. *S Afr Med J* 1992; **81:** 74-76.
6. Liv D, Aitkenhead DR. Comparison of contemporaneous and retrospective assessment of postoperative pain using the usual analgesic scale. *Br J Anaesth* 1990; **65:** 577-578.