Continuous narcotic infusions for relief of postoperative pain

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Summary and conclusions

Relief of acute pain after surgery or trauma is still inadequate in many centres, most patients being treated with intermittent intramuscular injections of narcotic analgesics. Over the past three years continuous intravenous narcotic infusions have been used at this hospital to treat postoperative pain; recently a system has been devised whereby an hourly dose is given and the dispenser recharged every hour. The method used is cheap and reliable, and signs of overdosage may be easily checked by nursing staff. Side effects rarely occur. Fifty patients who had received intravenous infusions after undergoing major abdominal surgery were sent a questionnaire to assess postoperative pain, and the results were compared with those from 50 matched controls who had received intramuscular injections. Of those who replied, only four patients who had received the infusion had found the pain distressing compared with 13 controls.

Continuous narcotic infusions are most effective in relieving postoperative pain and may be given cheaply and reliably.

Introduction

Adequate pain relief after operation is called for by both patients and doctors,[1 2] the morbidity from pain after surgery being well recognised and documented.[3] Adequate means of controlling pain using segmental nerve blockade, inhalation agents, and narcotic analgesics are available, but most patients are habitually prescribed intramuscular analgesics by surgeons and anaesthetists without thought to dosage, frequency of administration, or response. At this hospital over the past three years we have used continuous narcotic infusions to treat postoperative pain, and over the past year have devised a system of providing safe, effective infusions at minimal cost. I here describe this system and show its advantages in treating postoperative pain.

Methods

When the patients have left the operating theatre those for whom a pethidine infusion would seem appropriate are prescribed pethidine 600 mg in 1 l compound sodium lactate solution. This is prepared and administered by the recovery ward staff and run through a side arm of the maintenance infusion via a microdrop dispenser (Metriset) at a rate of 0·5 ml/kg/h (0·3 mg/kg/h) after a bolus dose of one hour's infusion volume has been given rapidly. This is given only when there are no signs of delayed recovery from anaesthesia. This provides adequate analgesia in about 80% of patients but may be insufficient or excessive in the other 20% and a further adjustment may be necessary within the first four hours. The prescribed infusion rate is then dialled on a drip regulator (Dial-a-Flow). Only the hourly dose is added to the chamber of the microdrop dispenser, which carries a warning notice (fig 1). Thus the nurse is required to carry out the instructions on the notice when she recharges the dispenser each hour. The advantage of having a high concentration running through a side arm of the maintenance infusion is that it is independent of that infusion, which may be of blood, colloid, or alimentation fluid.

THIS PATIENT HAS A PETHIDINE INFUSION

Please ensure that the Metriset is charged every hour with the prescribed hourly dose only, and count the respiration rate. If less than 10 per minute stop the infusion and call the anaesthetic duty registrar.

HOURLY DRIP RATE_____ ml

FIG 1—Warning notice added to Metriset microdrop dispenser.

Should the patient receive an overdose of narcotic the respiratory depression may be rapidly reversed with naloxone; this has been necessary in only three cases in this hospital. In one case the patient had an undiagnosed phaeochromocytoma and his profuse sweating was misinterpreted as being a response to severe pain. Two other patients were receiving morphine 0·03 mg/kg/h instead. All three patients responded immediately to an intravenous injection of naloxone and the drip rate was adjusted accordingly. The infusion may be continued indefinitely and after the operation is usually continued until the maintenance infusion is removed. Patients with severe trauma often need analgesia for much longer and may benefit from a narcotic infusion for up to 10 days. There has been no evidence of dependence in these patients, and the change to oral non-narcotic analgesics has not presented any problems.

During an eight-month period this protocol was used in over 300 adult patients who had undergone various procedures. It was also used in children, including neonates requiring surgery to correct congenital abnormalities such as tracheo-oesophageal fistula, diaphragmatic hernia, exomphalos, and hare lip. In children weighing under 40 kg a constant infusion pump was used routinely to deliver the dose, the observations being made hourly in the usual way.

Results

Over a two-month period 50 patients who had had a continuous narcotic infusion after major abdominal surgery were sent questionnaires after their discharge from hospital to obtain a subjective assessment of postoperative pain. Over the same period a second group of 50 patients matched as closely as possible for age, sex, and operation but who had had conventional intramuscular analgesia were sent the same questionnaire, again shortly after discharge. Although in many cases the same surgeons operated on patients in both groups, the groups were in different wards. In the "infusion" wards it was common for patients to receive continuous narcotic infusions, and they were not informed that they were having an unusual form of pain relief.

Of the 100 patients questioned, 71 replied. The table shows the results. Patients replying to category C or D were considered to have been inadequately treated, and, interestingly, this applied to only four of the 37 patients who received intravenous analgesia compared with 13 out of the 34 who received intramuscular narcotics. Clearly the

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Analysis of replies to questionnaire sent to 100 patients who received intravenous infusion or intramuscular injection after undergoing major abdominal surgery

	Intramuscular injection	Intravenous infusion
(A) I did not feel any pain or discomfort after my operation	1	4
(B) I was mildly uncomfortable but not distressed by any pain	20	29
(C) I was most uncomfortable and found the pain distressing	12	3
(D) The pain and distress were so bad that I should be reluctant to go through the experience again	1	1
Total No of replies	34	37
(C) and (D) as % of total	38	11

patients who received intramuscular narcotics were not given the same total daily dose as those in the intravenous group. Those given intramuscular pethidine received a mean of 3·5 mg/kg/24 h, whereas the patients given continuous pethidine infusions received 7·2 mg/kg/24 h. The postoperative prescription for the intramuscular group, however, was 75-100 mg pethidine every four hours on demand, so provision was made for a much higher total dose. This emphasises the inadequacy of the "on-demand" intramuscular prescription.

Discussion

While various methods are available for controlling pain, effective postoperative analgesia is still a luxury that is withheld from too many patients. In a psychometric study of patients after operation Cronin and Redfern[4] found that half of their patients, receiving intramuscular narcotics for postoperative pain relief, classified their pain as "very unpleasant indeed; I would not like to go through this again." Narcotic analgesics, however, can be very effective in treating pain when given correctly. There is reluctance to give more than the time-honoured prescription of one ampoule every four to six hours for 24 hours. After 24 hours the patients are not expected to have any pain, and provision for postoperative analgesia is "someone else's problem." Ironically, the patient usually feels most pain during the second day, when the effects of the anaesthetic have worn off; the patient is often mobilised; and drainage tubes, intravenous infusions, and dressings become more distressing.

Absorption of intramuscular injections of narcotics is unpredictable,[5] particularly after surgery, when peripheral perfusion may be reduced and uptake prolonged. Side effects such as hypotension, nausea, and respiratory depression may occur after the patient has returned to the ward from the recovery area. Patients maintained on intramuscular analgesia postoperatively are not usually given further doses until the prescribed time has elapsed after their previous dose, and then only if they actually complain of pain. The interval between demand and administration will vary with staffing pressures, and that between administration and analgesia will depend on the rate of absorption and dosage. The period from demand to analgesia may extend to several hours, particularly if a four-hourly regimen is prescribed and the narcotic is pethidine or morphine.

A practical solution to this is the continuous narcotic infusion. By titrating the hourly dose to the patient's needs a steady plasma concentration of narcotic may be achieved that will provide adequate analgesia. Most would agree that this is the logical answer, but the reluctance of medical and nursing staff to use narcotics in adequate doses reflects an educational process that emphasises the dangerous side effects such as respiratory depression and addiction rather than the advantages of effective pain relief. The concept of continuous narcotic infusions is not new but there has always been a reluctance to use infusions owing to the difficulty in delivering the dose safely. Three problems exist—namely, devising a safe, cheap delivery system; a means of varying the dose to meet the patient's individual needs; and a monitoring device to detect signs of overdose.

Delivery system—A microdrop dispenser charged with only the hourly dose is a coarse but reliable system. If the drip rate is too fast the safety rubber flap will seal the line, when the hourly volume has been used. The chamber is not recharged until the beginning of the next hour. This is a precaution against the tap B (figure) being left open. The drip regulator is set for a predetermined drip rate, which will control the infusion should the taps A and B both be left open—so far this has not occurred. At this hospital the routine postoperative regimen is for patients to receive two litres in 24 hours through the maintenance infusion and a further 0·5 ml/kg/h in the form of a pethidine infusion. The maintenance infusion may be reduced if postoperative fluids are restricted. The further advantage of the side infusion is that should the patient become hypovolaemic for any reason the maintenance drip may be increased without fear of suddenly increasing the narcotic dose. Narcotic infusions will never be used routinely if they rely on expensive delivery systems such as the constant-volume infusion pump. No hospital could afford enough of these, at several hundred pounds each, to provide a continuous infusion service for all patients having major surgery. The system described here costs about £3.

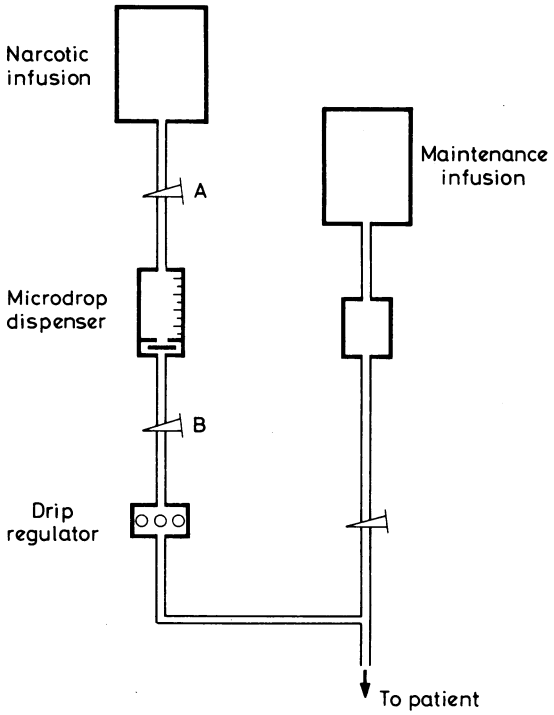

FIG 2—Delivery system showing narcotic infusion coming from side arm of maintenance infusion and drip regulator, which will control infusion should taps A and B both be left open.

Dose variation—The therapeutic blood concentration of pethidine appears to be 0·45-0·55 mg/l,[5] which may be rapidly achieved and maintained using the continuous intravenous route of administration. The reported wide fluctuations in dosage, response, and blood concentrations refer to intermittent intramuscular injections and are probably due to variation in the rate of absorption from the injection site. Occasions may occur, however—for example, during mobilisation and physiotherapy—when the analgesia is insufficient. By giving bolus aliquots from the hourly dose of narcotic infusion more profound analgesia may be achieved. The prescription is for an hourly dose and it matters little if this dose is given in under an hour provided the chamber is not recharged until the beginning of the next hour.

Signs of overdosage—Respiratory depression is a side effect for which narcotics are most notorious. Other side effects are

hypotension, nausea, dryness of the mouth, and rashes. The ward staff are familiar with the routine postoperative checks of blood pressure, pulse, and temperature, these being done hourly for the first six hours and four-hourly thereafter. After six hours enough time has elapsed for any abnormal response to the drug to be noticed. The most important value is the respiratory rate. This must be checked hourly and a clear indication given to the nursing staff of the minimum rate acceptable before action should be taken. The time taken to recharge the microdrop dispenser and count the respiration rate is just over a minute, but the routine of intramuscular injections is also time-consuming. Furthermore, a patient with no pain can help himself in bed more readily than one in pain, who may require constant nursing attention for minor nursing details; thus more time may be spent attending to the general well-being of the patients rather than complying with the stringent rules associated with the administration of intramuscular narcotics.

Almost undoubtedly the success of a continuous narcotic infusion rests on its management, and in wards in which the nursing staff are interested and involved the results are much better than in those where the staff are too busy or preoccupied to allow such treatment to work. Ideally a pain team should administer the postoperative analgesia: this could consist of a small group of interested and experienced nursing sisters under the direction of an anaesthetist. The team would be responsible not only for organising the narcotic infusion regimen but also for topping up epidural catheters on the wards.

I am indebted to the surgeons and anaesthetists for allowing me to develop this technique on patients under their care. I should also like to express my gratitude to the recovery ward staff and the pharmacy department for the help they have provided, and to Mrs Louise Boxwell for her secretarial help.

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Glycosylated haemoglobin concentrations in newly diagnosed diabetics before and during treatment

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Summary and conclusions

Concentrations of total glycosylated haemoglobins (Hb A_1) were measured in 40 diabetics at diagnosis and at monthly intervals after treatment with chlorpropamide, insulin, or diet alone was begun. The mean Hb A_1 concentration at presentation in 16 patients treated with chlorpropamide was significantly higher than that in 12 patients treated with insulin, and the duration of glycaemic symptoms was much longer in the chlorpropamide-treated group. In contrast, the mean plasma glucose concentration was similar in both groups. The mean concentrations of Hb A_1 and plasma glucose at diagnosis in the 12 patients treated by diet alone were lower than those in the other two groups, and most of these patients were free of symptoms. Treatment quickly relieved symptoms and lowered plasma glucose in all patients. The Hb A_1 concentration fell significantly with treatment such that after two months there was no significant difference between the three groups, although results remained above the normal range.

These findings support the theory that the Hb A_1 concentration reflects the blood glucose control over the previous one to two months and suggest that the duration of hyperglycaemia may be important in determining the Hb A_1 concentration as well as the absolute blood glucose concentration.

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Introduction

Haemoglobin A_{1c} (Hb A_{1c}) is produced via a post-synthetic glycosylation of haemoglobin A_1[1] probably by a slow and non-enzymatic process within the red blood cell throughout its 120-day life span, the concentration being highest in the oldest erythrocytes. Thus the concentration of Hb A_{1c} usually reflects the mean blood glucose concentration prevailing over the previous few months.[2] When the blood glucose concentration improves in poorly controlled diabetics raised Hb A_{1c} concentrations decrease towards normal values.[3] Ditzel and Kjaergaard[4] reported that raised concentrations of Hb A_{1c} in newly diagnosed diabetics fell towards normal two to four months after the start of treatment. All their patients, however, were treated with insulin, irrespective of age or the severity of hyperglycaemia at diagnosis, and all were initially inpatients. We have investigated a group of newly diagnosed diabetics, both insulin-dependent and independent, whose disease was of varying severity, in an attempt to correlate the concentration of total glycosylated haemoglobins (Hb A_1) with the duration of glycaemic symptoms