European Journal of Anaesthesiology 1994, 11, 413–415

A patient's experience of a new post-operative patient-controlled analgesic technique

M.G. Irwin, R. D. M. Jones, A. R. Visram and J. P. Kornberg

University Department of Anaesthesiology, Room 415, Block K, Queen Mary Hospital, Hong Kong

M.G. Irwin *et al.* (1994) *European Journal of Anaesthesiology*, **11**, 413–415
A patient's experience of a new post-operative patient-controlled analgesic technique

Summary

A patient underwent major spinal surgery, twice within a 3 week period. On the first occasion his post-operative pain was managed by conventional morphine patient-controlled analgesia (PCA). After the second procedure his pain was managed by a patient-controlled computer-assisted titration of alfentanil. This provided the opportunity to compare the efficacy of these two drug regimens in the same subject. The results showed comparable quality of analgesia and sedation and similar effects on respiration. However, the patient expressed a preference for morphine PCA.

Keywords: PAIN, post-operative; ANALGESIA, patient-controlled; ANALGESICS, alfentanil, morphine.

Introduction

Patient-controlled administration of analgesic drugs has become an important and effective technique for the treatment of post-operative pain [1]. Usually, relatively long-acting opioids such as morphine or pethidine are administered [2]. A system has been developed for the infusion of the short-acting opioid alfentanil at a rate designed to achieve and maintain a target blood concentration. An IVC 9000 computer (Anaesthesia Technology Ltd, Leeds, UK) has been programmed with the pharmacokinetic data for a patient population, adjusted for a particular patient's age, weight and sex. When pain relief is required, the target concentration can be increased by the patient pushing twice on a demand button within 1 s. The resultant increase in the alfentanil infusion rate will raise the predicted plasma concentration by 5 ng ml $^{-1}$. There is a lock-out interval of 2 min. The instrument is interfaced to an Ohmeda Biox 3700e pulse oximeter for continuous monitoring of oximetric data. If the oximetric saturation falls below 90%, the infusion is stopped automatically. If analgesia is not demanded during a 15 min period, the infusion rate declines by 5 ng ml $^{-1}$ to a new target concentration. If, subsequently, the button is not pushed, the 5 ng ml^{-1} decline will continue every 15 min during the first 4 h of use, every 30 min during the next 4 h period and every 60 min thereafter until the target concentration reaches the baseline value of 15 ng ml $^{-1}$. The infusion rate cannot be increased by interference with the pump or computer, but only by successfully pressing the demand button.

We report a comparison of conventional patient-control analgesia (PCA) bolus administration of morphine with a computer-assisted patient-controlled infusion of alfentanil, in a patient undergoing a posterior spinal fusion, followed 10 days later by an anterior spinal fusion, employing one of the analgesic techniques on each occasion.

Case history

A 56-year-old man, ASA 1, weighing 70 kg, presented with increasing back pain and symptoms of early spinal nerve root compression and was scheduled for a posterior spinal decompression and implant insertion from L4 to S1. On the day before operation, the concept of PCA was discussed with the patient, informed consent obtained, and he was familiarized with the device. Anaesthesia was

Accepted November 1993
Correspondence: Dr Michael Irwin.

induced with propofol 150 mg and morphine 8 mg. Neuromuscular blockade was achieved with atracurium 35 mg and IPPV instituted to achieve normocapnia. Anaesthesia was maintained with 60% nitrous oxide in oxygen with 1–2% isoflurane, analgesia being supplemented by further increments of morphine as appropriate. The operation was uneventful, lasting 5 h, with a total blood loss of 2000 ml. After reversal of residual neuromuscular blockade and extubation, the patient was transferred to a high dependency unit (HDU) where intravenous (i.v.) morphine was titrated to produce satisfactory analgesia. The PCA system (Abbott Lifecare) was primed with 1 mg of morphine per 1 ml of 0.9% saline and the delivery tubing connected to the side port of a Y-connector with an integral one-way valve. The machine was programmed to deliver a bolus dose of 1 mg, with a lock-out period of 5 min, without a background infusion. The patient received supplementary oxygen by means of nasal cannulae at a flow rate of 2 litres min^{-1} and was monitored with an electrocardiograph, direct arterial pressure and continuous pulse oximetry. For the following 24 h pain, sedation, respiratory rate, volume of morphine infused and any side effects were recorded hourly by ward nursing staff. Pain was assessed using an 11 point (0–10) numerical rating score (NRS) [3] and sedation was scored as follows: 1=anxious, agitated; 2=awake but tranquil; 3=drowsy (eyes often closed, but responds to name); 4=asleep.

The patient made an uneventful recovery and 10 days later underwent an anterior spinal fusion. Anaesthesia was as before except that instead of morphine, the patient received an alfentanil infusion to achieve an intra-operative target concentration of 30 ng ml^{-1}. The operation lasted 2.5 h and blood loss was 245 ml. Post-operatively he was transferred to the HDU where he was given the patient-controlled alfentanil infusion handset, having been instructed in its use the previous day. Post-operative therapy and monitoring was as before.

Discussion

Analysis of the patient's data from the first 20 h post-operatively on each occasion provided an objective comparison of these two analgesic regimens. The patient had difficulty in using the alfentanil PCA system despite pre-operative familiarization with the device. However, once he became proficient in its use and a predicted alfentanil target concentration in the range 54–64 ng ml^{-1} had been achieved, pain relief, respiratory rates and sedation scores were comparable to those achieved with morphine (Table 1). The total post-operative morphine PCA consumption was 17 mg, while a total of 16.6 mg of alfentanil was infused.

The alfentanil infusion was equally effective as an analgesic technique when compared to PCA morphine bolus administration, apart from the initial post-operative period when the patient experienced difficulties manipulating the handset, which delayed titration of the infusion rate to achieve satisfactory analgesia (Fig. 1). Two of the intrinsic safety features of the infusion device which make accidental demands less likely are the recessed button in the handset and the requirement for double activation of the button to permit successful drug delivery. Although these features are recommended by other workers [4], this patient had difficulty in mastering the system, despite pre-operative practice. A more user-friendly hand device is required for patients who suffer restricted hand mobility or co-ordination due to residual effects of anaesthesia, old age, disease or surgery.

There were no adverse effects or incidents recorded with either drug. Infusion administration via a dedicated line did not cause venous irritation and eliminated the potential problems associated with back-flow of analgesic into a parallel infusion line if the one-way valve malfunctions.

Most opioid analgesics have been used in PCA and can provide good pain relief after surgery [5]. Alfentanil should demonstrate some advantage over other agents because of its ability to rapidly achieve effective equilibration between the plasma and site of drug effect [6]. This should permit the patient to achieve a satisfactory level of analgesia with a lower risk of 'overshooting' the therapeutic range. Previous studies have suggested that at analgesic levels equipotent with morphine, alfentanil produces less sedation [7] and this may be potentially

Table 1. Numerical rating score (NRS) for pain, sedation score and respiratory rate for each technique

	Alfentanil	Morphine
NRS	4 (2–8)	2 (0–4)
Sedation score (1–4)	2 (2–4)	2 (2–4)
Respiratory rate (min^{-1})	20 (18–20)	20 (16–24)

Median (range).

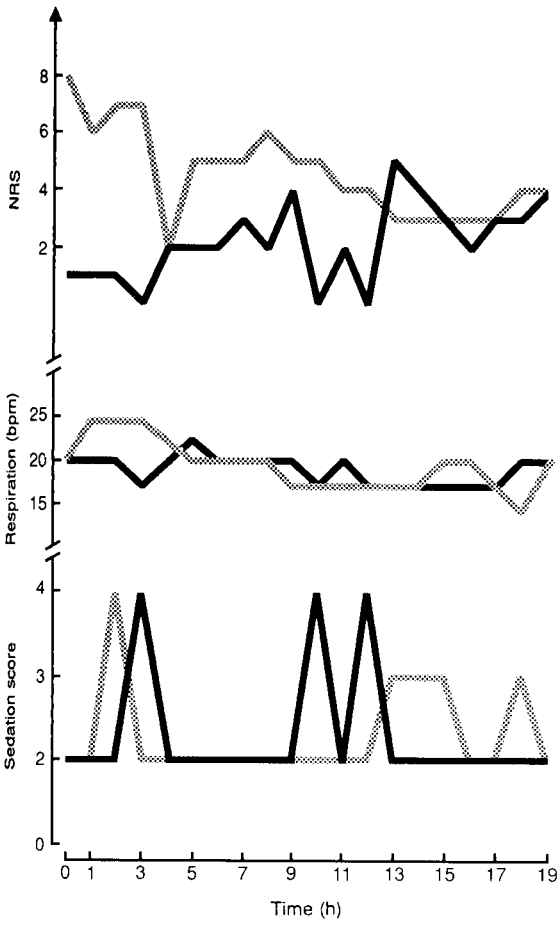

Fig. 1. Pain scores (NRS), sedation scores and respiratory rates recorded during alfentanil infusion and morphine PCA. Alfentanil, ▨; morphine, ■.

advantageous in certain circumstances. However, when questioned 1 week post-operatively, our patient revealed that he felt restless and considered his sleep of poorer quality compared to that experienced after the first operative procedure with morphine analgesia. This was despite having similar sedation scores and comparable pain scores. The experience of pain after the first operation may have fundamentally changed the appreciation of pain after the second procedure. Furthermore, the analgesia delivery system was not blinded and, therefore, the assessments may have been subject to observer bias.

Although the two operations may differ in their propensity to cause post-operative pain, it is useful to compare the efficacy of the two systems from a single patient's perspective. When asked which system he would prefer for future surgery, he expressed a strong preference for morphine PCA.

This is the first report of the use of a patient-controlled, pharmacokinetic-based infusion of alfentanil and observations based on a single patient are limited. Although more experience with this new technique may change the conclusion in future studies, the case illustrates in a single patient cross-over comparison that this was a safe and effective way to achieve and maintain analgesia but that, in the clinical setting described, the apparently stronger sedative effect of morphine was preferred by the patient.

Acknowledgment

We express our thanks to Dr G. N. C. Kenny (Senior Lecturer, University Department of Anaesthesia, Glasgow Royal Infirmary) for supplying the patient-controlled computer-assisted titration device, and for reviewing this manuscript.

References

1 Rowbotham DJ. The development and safe use of patient-controlled analgesia. *Br J Anaesth* 1992; **68**: 331–332.
2 Mather LE, Owen H. The scientific basis of patient controlled analgesia. *Anaesth Intensive Care* 1988; **16**: 427–436.
3 Katz J, Melzack R. Measurement of pain. *Anesthesiology Clin North Am* 1992; **10**: 229–245.
4 Lassner J, Norman J. Future work on patient-controlled analgesia: summary of open discussion. In: Harmer M, Rosen M, Vickers MD, eds. *Patient-controlled analgesia*. Oxford: Blackwell Scientific Publications, 1985: 191–194.
5 Lehman KA. Autoregulation de l'analgesie postoperatoire. *Cah Anesthesiol* 1985 **33**: 119–123. Autoregulation of post-operative analgesia (English title).
6 Stanski DR, Hug CC Jr: Alfentanil – a kinetically predictable narcotic analgesic. *Anesthesiology* 1982; **57**: 435–438.
7 Owen H, Brose WG, Plummer JL, Mather LE. Variables of patient-controlled analgesia. 3: Test of an infusion-demand system using alfentanil. *Anaesthesia* 1990; **45**: 452–455.