EVALUATION OF A DISPOSABLE PATIENT-CONTROLLED ANALGESIA DEVICE IN CHILDREN

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SUMMARY
A disposable patient-controlled analgesia (PCA) device was evaluated in 20 children after major abdominal, urological and orthopaedic surgery. All patients were given a high dependency level of nursing care in general wards. Efficacy (as assessed by hourly pain scores) was comparable to that achieved in a matched control group of 20 children who used the Graseby PCA system. Safety was confirmed by monitoring arterial oxygen saturation, sedation scores and ventilatory frequency. Morphine consumption was similar with the two techniques, but varied widely between patients. The disposable device has a complementary role to play in the provision of a comprehensive pain relief service for children.

KEY WORDS

Pain management techniques in paediatric patients have been reviewed comprehensively recently [1]. Patient-controlled analgesia (PCA) may be used safely in suitably selected children of a minimum of 5 years of age [2]. PCA is an important technique [3] and suitable dosage regimens and monitoring procedures have been developed for children [4]. The present study was undertaken to compare the clinical performance of the disposable PCA infusor (Baxter Healthcare Ltd, Thorpe Lea Manor, Thorpe Lea Road, Egham, Surrey TW20 8HY) [5,6] with an electronic PCA system (Graseby Medical Ltd, Colonial Way, Watford, Herts WD2 4LG) in children after major surgery.

METHODS AND RESULTS
We studied 40 children aged 4–17 yr undergoing major abdominal, urological or orthopaedic surgery. PCA devices were used after operation as part of a large study of various PCA techniques for which hospital Ethics Committee approval had been granted. Parental consent was obtained for the use of PCA and all children were visited beforehand to have the technique explained and to practise with demonstration models. An assessment was made of the child's ability to understand and use the devices. Twenty children used the disposable PCA infusor (fig. 1). The elastomeric reservoir of the infusor was filled with morphine sulphate 2 mg kg⁻¹ in 0.9 % saline 50 mL. The infusor (2C1073) empties at a constant rate of 5 mL h⁻¹ into a wristwatch-style patient control module which incorporates a reservoir with a volume of 0.5 mL. Flow occurs into the reservoir until it is full and then ceases. No flow can go to the patient as the outlet from the reservoir is occluded by a spring-loaded pinch mechanism. When the button on the wristwatch is pressed, this occlusion is released and a bolus dose of morphine 20 μg kg⁻¹ is delivered into the i.v. cannula via a one-way valve. The reservoir in the watch is refilled in 6 min, providing a nominal lockout interval of 6 min (this is not a true lockout interval, because button presses within this 6-min period cause any contents which have accumulated in the wristwatch reservoir to be delivered). No background infusion was used.

The monitoring regimen developed by our department [4] was used to assess efficacy (hourly pain scores), adverse effects (hourly sedation scores, continuous arterial oxygen saturation while breathing room air recorded hourly, hourly ventilatory frequency, occurrence of nausea, vomiting and venous sequelae) and morphine consumption (residual volume of reservoir recorded hourly). With this procedure, excessive sedation is defined as a sedation score of 4 (unrousable) and significant respiratory depression is defined as a ventilatory frequency of 12 b.p.m. associated with desaturation to 90 % in a child aged 5 yr or more. All children were managed in the general ward situation with a high dependency level of nursing care (one nurse per two patients). Each child who used the disposable device was paired with a child of the same age and weight undergoing the same operation who used the Graseby electronic PCA system programmed to deliver morphine 20 μg kg⁻¹ with a lockout interval of 5 min and no background infusion (our current PCA regimen). These children were assessed and managed in the same way. All children in the study had an appropriate regional block for intraoperative and early postoperative pain relief.

The results (table I) show that equally good analgesia was achieved with both systems as demonstrated by the low hourly mean pain scores. This is supported further by the fact that only 34 individual...
scores of 2025 recorded were rated as “very sore” (19 in the Graseby group, 15 in the disposable infusor group). No instances of oversedation or significant respiratory depression occurred. \(\text{SpO}_2\) values were nearly all in the range 95–100%. The nadir of \(\text{SpO}_2\) was 87% in the group using the disposable device and 90% in the group using the electronic system. These desaturations were transient and were not associated with slow ventilatory frequencies or oversedation. The incidence of nausea and vomiting was comparable in each group. Mean morphine consumption was similar in the two groups with a 4- to 5-fold range of utilization.

**COMMENT**

The clinical performance of the disposable PCA infusor was satisfactory in our children, providing as good analgesia as the electronic PCA device. Adverse effects were minimal and comparable in severity. Most children were managed satisfactorily with the PCA settings used in this study. Previously, we used a longer lockout interval of 10 min [4]. Experience gained in a subsequent 50 children undergoing major surgery has led us to conclude that a shorter lockout interval allows the child to achieve an acceptable level of analgesia more rapidly. The disposable infusor is inherently less flexible than electronic devices, in that dosage and lockout interval are fixed when the device is filled. Morphine requirements varied widely between patients and at different times in an individual patient’s postoperative course. PCA settings may therefore have to be adjusted to achieve optimum analgesia while minimizing adverse effects. No children in this study, however, required adjustment of bolus dose size or lockout interval.

We did not use a background infusion in this study, but another version of the device is available which allows a background infusion by incorporating two Y-pieces in the circuit such that one limb bypasses the wristwatch reservoir.

An incorrect concentration of drug may be used when filling either system. The only other “programming error” with the disposable device would be to use the wrong infusor, as three models are
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available which empty at different rates (0.5, 2 and 5 ml h\(^{-1}\)). The pattern of demands cannot be charted for the disposable device, but morphine consumption may be measured by recording the rate of emptying of the reservoir. Small children may have difficulty in activating the devices, particularly when drowsy or when visual accommodation is affected by opioids. We found that some children were more able to locate and operate the wristwatch button of the disposable device when it was worn on the palmar aspect of the wrist. Most children using PCA devices for postoperative analgesia need initial reminders and encouragement to recognize when and how to activate the system and this applies equally to electronic and disposable systems.

We conclude that suitably selected children aged at least 5 yr may use PCA safely if a high dependency level of nursing care and a monitoring regimen are used to assess efficacy and adverse effects. The disposable device is an alternative to electronic systems and may have advantages in terms of cost; there is less capital outlay, no maintenance cost and less wastage cost when the device is not in use.

REFERENCES