

coincident with the highest CO<sub>2</sub> value in the respiratory cycle. All instruments generate numerical values of P<sub>ETCO<sub>2</sub></sub>, while many devices also record a continuous CO<sub>2</sub> waveform.

For the sake of scientific clarity and uniformity of usage, the measuring, display in numerical form, and clinical interpretation of P<sub>ETCO<sub>2</sub></sub> values should be called capnometry (from the Greek word *metrein*, to measure) when such is the primary purpose of employing the monitor, while the term capnography (from the Greek word *graphein*, to write) should be reserved for situations in which the recording and analysis of a continuous CO<sub>2</sub> waveform is of primary importance.

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## Problems and Innovations in Home-Based Patient-Controlled Analgesia with Epidural Opioids

*To the Editor:*—Our recent experience in a patient who had pain related to preterminal malignancy revealed two problems associated with chronic home-based PCA therapy that to our knowledge have not been reported. The patient identified these problems himself and proposed novel solutions that proved to be effective.

A 60-yr-old white male corporate executive with advanced rectal carcinoma confined to the pelvis was referred to the Cancer Pain Service. He had undergone two exploratory laparotomies, colon resection, colostomy, nephrostomy, and insertion of a Hickman catheter for the administration of parenteral alimentation. There was a draining perineal sinus, invasion of the bladder, and severe pain in the perirectal and genital regions. Early analgesic intervention consisted of serial saddle blocks with hyperbaric 10% phenol in 1–2 ml aliquots, supplemented by low-dose iv morphine (1–2 mg/h, prn) delivered on patient-demand by a Pharmacia Deltec infusion device.

Over a period of 9 months, pain increased in severity and the efficacy of further nerve blocks decreased, presumably due to a combination of extension of tumor and sheathing of the targeted nerve roots with fibrosis or tumor. As requirements for iv morphine increased to up to 60 mg daily, increased sedation and impaired gastrointestinal motility were observed. Hospitalization was required for intractable vomiting that persisted despite conservative management.

Epidural opioid therapy was elected in order to provide control of pain while limiting the patient's opioid intake. The epidural route was selected in preference to subarachnoid administration in order to limit the likelihood of central nervous system infection. After a successful trial with preservative-free morphine administered *via* a standard percutaneous epidural catheter, an indwelling silastic epidural catheter (Daval) with an externalized injection port was implanted. The patient's Pharmacia Deltec pump was used to provide a continuous infusion of 0.5 mg/h morphine for basal analgesia, and the pump was programmed to deliver 2-mg boluses of epidural morphine hourly on patient demand. Overall pain control was excellent and bowel function returned steadily during the first post-treatment week.

### PROBLEM 1

In an effort to limit the absolute quantity of morphine administered, the patient resisted recommendations of the treatment team to increase the basal rate, and as a result required self-administered boluses of epidural morphine regularly during the night. On each of these occasions full arousal from sleep was necessary to illuminate the room

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### REFERENCE

1. Kelleher JF: Pulse Oximetry. *J Clin Monit* 5:37–62, 1989

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and orient himself so he could accurately locate the bolus button (one of six similar controls).

*Solution.* The patient resolved this problem independently by simply applying a narrow strip of textured adhesive tape to the unit's bolus button (fig. 1). This facilitated location of the button in the dark without the necessity for full arousal and prolonged interruption of sleep.

### PROBLEM 2

On three occasions the patient experienced undesirable sedation and confusion when boluses were demanded sooner than truly needed for pain control. The patient explained that in these instances, he appropriately self-administered an initial bolus in response to pain. Mildly confused, he "forgot" the first intervention and, thus, followed it sooner than necessary with a repeat demand. This additional dose heightened

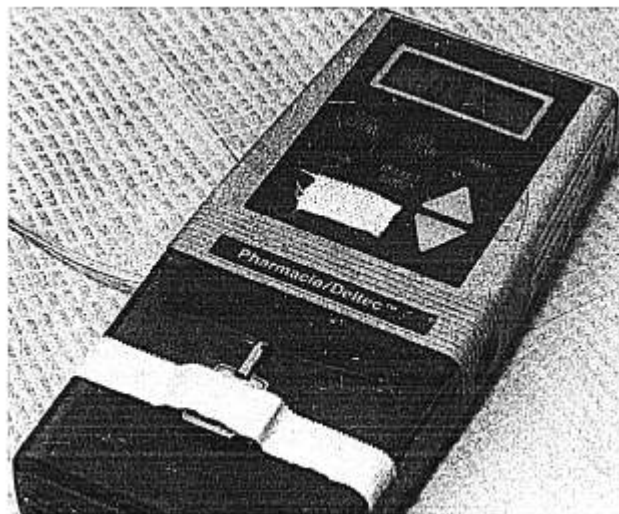


FIG. 1. Portable drug infusion pump used for combined continuous and patient-controlled epidural opioid analgesia. Note upper strip of adhesive tape (center) placed (by patient) over bolus button to facilitate operation during nighttime hours.

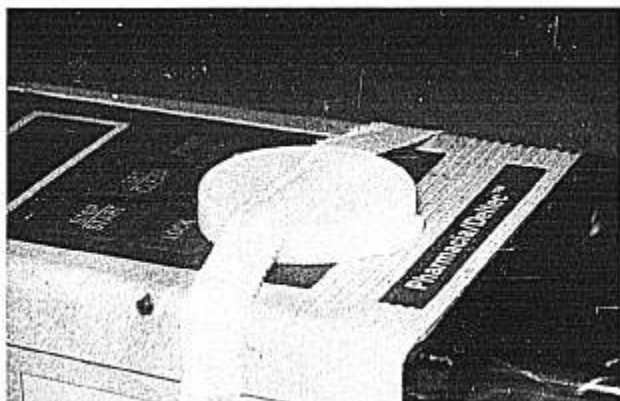


FIG. 2. Note medicine cap taped (by patient) over bolus button to discourage overuse of bolus feature during daytime hours.

his confusion and initiated a spiraling pattern of medication excess, confusion, and sedation.

**Solution.** The patient was followed closely by the pain management team, but these events occurred in the space of just a few days and were not reported. Had these events been described, efforts would have been made to prevent their repetition by altering the prescribed lockout interval and dose. Instead, the patient again undertook independent problem solving with good results. He carefully taped a cap from one of his medication vials over the bolus button, reasoning that the effort and forethought required to remove the cap would serve as a deterrent to unintended overuse of the device's bolus feature (fig. 2). No further incidents of overuse followed this intervention.

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### Oral Midazolam for a Mentally Retarded Patient

**To the Editor:**—We were recently asked to anesthetize a muscular 18-yr-old mentally retarded (I.Q. of 60) male who presented to our outpatient facility for proctoscopy for diagnosis of rectal bleeding. Upon presentation to the preoperative area he became frightened to the point of panic. He could not be approached by anyone except his mother. Because of his emotional state, size, and strength, attempts at intramuscular sedation were impossible. His mother attempted to get him to accept intranasal sufentanil but he would not allow this either.

Therefore, based on the studies cited,<sup>1,2</sup> we elected to administer oral midazolam (0.6 mg/kg). Although the dose used in the above studies was 0.2 mg/kg, we chose the higher dose because of his extreme state of anxiety, the possibility of paradoxical effect with lower doses, and "first pass" hepatic metabolism of about 50–60% when given by the oral route.<sup>3</sup>

Other than his rectal bleeding and mental retardation, he had no other known medical problems and was A.S.A. physical status 1. His daily medications included pemoline 50 mg bid and thioridazine 25 mg bid.

The medication was prepared by mixing 30 mg of midazolam in 25 ml of a carbonated cola beverage. The pH of the resultant mixture was 3.8; this acid pH allowed the midazolam to remain in solution. The cocktail was then administered by his mother. The patient complied by ingesting the entire amount (31 ml) without incident. Continuous observation by the anesthesia staff was begun following ingestion.

This case illustrates the potential role for innovative pain relief modalities (neuroaxial administration of opioids, patient-controlled analgesia) and their adaptability to the environment of the home. These measures were indicated in this case because analgesia was incomplete despite efforts at control using more conservative means, and because iv opioids seemed to be responsible for impaired mental status and gastrointestinal dysfunction.

Both of these problems probably could have been resolved by alterations in medication orders, but in this case they were reconciled by novel solutions proposed by the patient. The details of this case were reported to the equipment manufacturer and interestingly, they have announced that the new model of this pump features a textured bolus button that can be readily identified in the dark.

This case also serves as a reminder that patients may have valuable insight into the nature of their problems, and that on occasion they may make important contributions to problem solving.

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Within 10 min he was sedate enough to allow physical examination and application of a pulse oximeter. Within 20 min he was somnolent but responsive to verbal stimulus. At this point an iv catheter was inserted and blood for preoperative lab work was obtained without objection. Forty minutes after ingestion, general anesthesia was induced with 250 mg of sodium thiopental and maintained with 1% isoflurane by mask for 1 h 20 min. The volume of the cocktail was small and the risk of aspiration was therefore felt to be quite low. Also, because of the relatively noninvasive procedure, tracheal intubation was not felt to be warranted. A recovery period of approximately 3½ h was required before the patient was "fully awake." He was discharged home shortly thereafter under the care of his mother.

We feel that some caution must be used with this regimen because of the possibility of paradoxical reactions in aggressive patients, as well as the risk of oversedation. Keeping these possibilities in mind, however, oral midazolam might be considered for anxiolysis and sedation for children and mentally retarded or otherwise uncooperative individuals.

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