

Patient-Controlled Analgesia (PCA): A Retrospective

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WHITE'S EXCELLENT REVIEW of patient-controlled analgesia (PCA)¹ is welcomed by all who were involved in the development of the field. For the sake of completeness and to provide a fuller view of the early history of PCA, the following is offered as a supplement to the material covered in White's JAMA Special Communication.

The idea of permitting patients to control their own analgesic regime occurred to me while I was attending the February 15-17, 1965 Nathan B. Eddy NRC Conference on Drug Addiction and Narcotics at the Baylor University College of Medicine. The concept is a rational extension of operant psychologic technique as an objective method of studying behavior. That is, the behavior of patients controlling their own analgesia could be structured in a fashion analogous to that of an animal terminating a painful stimulus by pressing a bar. The rate of response (bar pressing) would be the basic, most direct measure of behavior.

If patients were allowed to operate a demand system directly controlling analgesic dosage I hypothesized, they would respond to their pain by pressing the activating button until the personal threshold of pain relief was reached. The patients' response (button pressing) or analgesic demand would be a measure of the pain and all its associated phenomena.

In addition to providing satisfactory pain relief, three strategies were projected. If "standard" analgesic drugs were used in such a patient-controlled system, pain could be described in terms of analgesic demand. However, if the material is an inactive-control solution, a description of pain and pain relief distinct from pharmacologic action (*i.e.*, the placebo effect) would be delineated. Finally, new analgesic drugs and pain therapies could be evaluated by comparing respective analgesic demands in appropriately designed studies.

With support from the M. E. DeBaake Fund a simple apparatus was constructed and initial data collected in the Cardiovascular Intensive Area of the Methodist Hospital, Houston Texas. The first presentation was made to the

Argentinian Angiology Congress at Buenos Aires, Argentina in 1966.² At the American Society of Anesthesiologists meeting in September 1967 a report was made that was subsequently published in ANESTHESIOLOGY.³

While gathering the initial data demonstrating the feasibility of the concept, I was working on the difficult problem of building an automatic drug administration and recording system that would respond to and document the patient's button pressing. A number of pump, pharmaceutical, and computer companies were approached but it was impossible to generate interest and support.

In 1966, I joined the faculty of what is now the SUNY Health Science Center at Brooklyn, New York at Maimonides Medical Center and funds were made available by the J. Aron Foundation to support a developmental laboratory. Commonly available pumps were evaluated against strict criteria that were essential for safe dependable function. Among these were sterilization and continuing delivery of sterile material; precise, consistent and replicable delivery of set dose; and ease of and maintenance of standardization and calibration.

A Holter Company roller pump most closely met the requirements and a modified unit was incorporated into the setup. Since an important objective was description of pain in behavioral terms, psychology laboratory recording equipment was adapted. By 1968, the apparatus was in use to treat pain in postoperative patients. Treatment was started in the postanesthesia recovery room and continued in the patients' rooms. The patients were their own controls; inactive-control solution was initially infused because previous studies showed that the requirement for postoperative analgesic medication varies considerably.³ Test analgesic drug was introduced when the demand met the criterion for transfer to delivery of active medication. That not every patient experienced sufficient postoperative pain was shown by the failure of some patients to button-press to reach the demand criterion.

Close monitoring by nurse observers was required to maintain patient safety, to assure that the apparatus functioned properly, to assure satisfactory analgesia, and to record physiologic (*e.g.*, vital signs), and psychologic data (*e.g.*, pain scores). A study was then initiated to compare analgesic demand as a measure of postoperative pain in upper abdominal, lower abdominal, and peripheral surgical procedures.

At the 1968 World Congress of Anesthesiologists, data were presented of the initial 20 studies that included de-

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tailed observations with opioid and nonopioid analgesics with inactive-control solution and with placebo-control solution. The procedure and apparatus were described in the Proceedings.⁴

That same year, the team took part in a demonstration of the procedure and apparatus at the 1968 New York State Society of Anesthesiologists Postgraduate Assembly. Interest was shown by the large number of anesthesiologists and associates that came to view the working machine.

Treatment of patients continued and data were collected so that by March 1970 results with 118 subjects were reported at the meeting of the International Anesthesia Research Society.⁵ It is interesting to note that the first few words of that paper, (*i.e.*, "A patient-controlled analgesic-demand . . .") effectively codified the name of the procedure and the apparatus.

It is not unusual in the history of science, philosophy, or medicine for new concepts to arise independently in different places at about the same time. I later learned through publication and personal contacts at meetings that others were developing similar notions for treatment of pain. Difficulties encountered between the development of the idea, obtaining financial support, the construction of an apparatus, the design of studies, gathering data, and publication resulted in delaying the various publications until the early seventies.

J. S. Scott of Leeds, United Kingdom had been applying what he called the "self-service" principle to patients in labor. He permitted the patients to operate a hinge-lever spring clamp that controlled the iv drip flow of analgesic. He compared the iv method to the self administration of inhalational anesthetics with a Minnitt-type machine. Report of this work was presented as part of the 1969 Joseph Price Oration before the American Association of Obstetricians and Gynecologists.⁶ W. H. Forrest and his associates at the Palo Alto Veterans Administration Hospital used a commercially developed "Demand Dropmaster" to provide "rapid, safe pain relief."⁷

I had the closest collegial relationship with the late Michael Keeri-Szanto of London, Ontario, Canada.⁸ While I was more concerned with the "scientific" aspects of studying pain and pain relief while providing patient pain relief, Keeri-Szanto was completely clinically oriented and eventually developed a commercial machine. In the early years we used to meet regularly at national meetings and we would discuss mutual problems and interests and share experiences.

The development of microprocessors led to rapid progress in the technology of programmable pumps. As these became available, interest in the clinical potential became widespread and this technique of pain therapy was subsequently evaluated in many centers. It is most gratifying to note that there have been many reports published which replicate the findings mentioned in the comments and summary in my early papers. On the other hand it is unfortunate that the "nontherapeutic" attributes have not been pursued. Other than studies of a few recently introduced drugs, and a recent study to evaluate a new pain therapy,^{9,†} to my knowledge there have been no studies of pain *per se* in terms of analgesic demand; no studies of pain or pain relief distinct from pharmacologic action; and no studies of the placebo effect. The potential of the analgesic-demand method as an applied operant psychologic technique for the objective description and measurement of pain should not be overlooked.

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† VadeBoncouer, Reigler, Gautt, and Weinberg compared PCA dosages to evaluate the effectiveness of intrapleural bupivacaine. The button-pressing (demand) data were not reported; not permitting an operant behavioral analysis.