

A Better Way to Deliver Oral PRN Pain Medication in Today's Hospitals

Technology Provides More Frequent Dosing Intervals versus Traditional Manual Administration

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Summary

Pain management for surgery patients has not significantly improved over the past 20 years in spite of new technology and various position papers from pain related societies. Multimodal pain management has evolved in an effort to reduce surgical pain by targeting pain signals and receptors using a variety of medications and techniques. New surgical innovations and changes in traditional surgical practice are aimed at shortening the length of stay and reducing surgical patient morbidity. As part of this effort, the use of parenteral opioids for pain management is minimized or deleted in favor of oral opioids as needed (PRN) with fewer known side effects and equivalent analgesia. The adoption of an electronic oral patient-controlled analgesia device (OPCA) called the MOD[®], for Medication on Demand, provides a more frequent dosing alternative to the manual delivery of oral pain medication for better pain management as well as saved nursing time.

Pain management for surgery patients – A need for continued improvement

Pain management is the most important concern of patients before surgery, with 50% reporting high anxiety about pain prior to surgery. Among U.S. adults who had surgery within the past 5 years, 75% reported moderate or extreme pain after their surgery during their hospital stay (Gan, Habib, Miller, White & Apfelbaum, 2014). Poor pain control following surgery is known to interfere with sleep, appetite, morale, physical therapy, and the motivation for recovery which impacts length of stay and overall outcomes (Morrison, et al., 2003; Samaraee, Rhind, Saleh & Bhattacharya, 2010; Vadivelu, Mitra & Narayan, 2010). Inadequate acute pain management can also result in the induction of chronic pain in some patients (De Oliveira, et al., 2014; Peters, Sommer, van Kleef & Marcus, 2010; Pinto, McIntyre, Ferrero, Almeida & Araujo-Soares, 2013).

Six published national patient surveys of patient pain control from 1994 to 2011 show little, if any, improvement in overall inpatient pain management in U.S. hospitals (three surveys) and E.U. hospitals (three surveys) as summarized by Correll, Vlassakov, and Kissin (2014). Gan, et.al. (2014), asked 300 U.S. adults within five years of surgery to assess the severity of their perioperative pain and their satisfaction with pain management. This data again showed little improvement in postsurgical analgesia in spite of multiple guidelines and position statements for improving post-operative pain management from pain related specialty organizations (Apfelbaum, et al., 2012).

Multimodal pain management

Multimodal pain therapy has been adopted to improve pain management for surgery patients. The intent is to combine medications to block pain at multiple receptors and pathways along with approaches to block the transmission of pain signals either with a neuraxial approach with spinal or epidural anesthesia, regionally using peripheral nerve blocks, or locally with direct wound infusions of local anesthetics. This method starts in the preoperative holding area and continues until discharge (Parvizi & Bloomfield, 2013). No gold standard exists for the best regimen/combination for specific surgeries since no standard evidenced-based approach is applicable to all scenarios. Each institution and surgical team is responsible for developing their own approach for best pain management.

Innovations result in oral opioid use earlier in the hospital stay

Innovations in anesthesia, robotics, laparoscopy, and changes in traditional surgical management have shortened the hospital stay for many patients, enabling a rapid transition onto oral pain medication (Health Quality Ontario, 2010; Miller, et al., 2014). Targeted peripheral nerve blocks, for example, for orthopedic joint surgery have reduced the need and/or duration of parenteral opioids postoperatively or allowed patients to completely bypass parenteral opioids and begin oral medication for pain management the day of surgery. Several surgical groups have reported that oral opioids are as effective as parenteral opioid management following surgery (Davis, Esposito and Meyer, 2006; Pearl, et al., 2002; Rajpal, et al., 2010; Rothwell, et al., 2011; Ruetzler, et al., 2014;). Enhanced Recovery After Surgery (ERAS) protocols are reporting the earlier use of oral pain medications and nutrition replacing the traditional approach of waiting for bowel resuscitation, thereby producing shorter hospital stays (Miller, et al., 2014; Tan, Law & Gan, 2015).

Whereas parenteral opioids are acknowledged to have a faster onset of analgesic action as compared to oral opioids, oral opioids can be as effective as parenteral opioids for pain management when the patient is able to take oral formulations. Oral opioids reduce the risk of sedation, respiratory depression, nausea and vomiting and constipation as compared to parenteral opioids (Conley, 2015; Rajpal, et al., 2010, Rothwell, et al., 2011, 2012). Oral analgesia is also much more cost effective than parenteral opioids and reduces the risk for other secondary effects from parenteral opioids that may prolong hospitalization such as ileus and urinary retention (Elsamra and Ellsworth, 2012; Gan et al., 2015). Few comparative studies of the adverse side effects of oral opioids compared to parenteral opioids have been reported with the exception of those comparing the two for pain management after surgery (Rothwell et al. 2011, 2012; Rajpal et al., 2010).

The status quo of PRN oral medication delivery

Since for many patients oral pain medications are starting earlier in the hospital stay, increasing their overall use, the burden upon nursing staff to administer these medications encumbers a significant portion of nurse shift time. The Joint Commission for hospital accreditation requires that the nurse obtain a pain score for each delivered dose of pain medication, followed by a return for a pain reassessment within a specified time interval after medication administration. Although the intent is to improve patient pain management, these added duties repeated multiple times during each shift are an inefficient use of nursing time that could be used for more direct, thoughtful patient care. Pizzi, Chelly, and Marlin (2014) reported the results of a timing study to measure the nursing labor time for the delivery of a single dose of oral pain medication in an inpatient orthopedic unit to be 10.9 minutes. From this data, if a nurse is responsible for six postoperative orthopedic patients during a 12-hour shift and these patients have a pain medication ordered every three to four hours as needed for pain, the nurse could spend two hours or more during the shift on the delivery of oral pain medications alone. A study in 2008 by the American Academy of Nursing Workforce Commission on inefficiencies of nursing care concluded that only the adoption of new technology by highly trained nurses will enable better patient care (Bolton, Gassert & Cipriano, 2008).

The general consensus is that the manual delivery of prn oral pain medications can only realistically be accomplished on a three- to four-hour basis by nursing. A three- to four-hour time interval between doses creates an initial high plasma drug peak for analgesia followed by a steep trough at the four-hour mark. A patient whose plasma drug concentration falls below the therapeutic analgesic range often asks for pain medication sooner than the ordered time between doses. When the required time interval has been reached and patients request their medication, the delivery is often further delayed by busy nursing staff or unanswered pages to physicians for an earlier dose. This compromises pain management and compounds the frustration and anxiety patients experience while waiting for on-demand delivery of oral immediate-release pain medication.

Patients in two Florida hospitals were enrolled in an IRB-approved nurse-blinded pilot study to measure the patient wait time experienced after requesting prn oral pain medications (MOD[®]-02 Clinical Study). Following informed consent, patients were given a card to record the request time of day and the level of pain on a numeric pain scale of 1 to 10. Once the nurse delivered the pain medication and left the room, the patient recorded the time of delivery, the pain score at the time of delivery, and whether the nurse requested the numeric level of pain from 1 to 10. Twenty-eight patients participated in the study. The mean wait time for all patients was 18.6 minutes according to patient data and 19.2 minutes according to charted data by nursing. The longest patient wait time was 109 minutes and the shortest was four minutes. Five patients (19%) recorded wait times of 30 minutes or longer. Of those five patients, four recorded a higher pain score at the time of medication delivery as compared to the score at the time of the request. Forty-one percent of the time, the nurse did not ask for a pain score at the time of the medication delivery.

Technology adoption can improve oral pain medication delivery and patient outcomes

Lambert and Cata 2014 demonstrated that a more frequent and efficient method for the delivery of oral pain medication improves patient pain management and provides less interference from pain with recovery parameters. Following total knee arthroplasty patients were divided into a control group with the (PRN) manual delivery of oral opioids compared to the delivery of oral opioids using the Medication

on Demand, i.e., MOD[®] oral PCA device. Patients using MOD[®] devices with oxycodone 5 mg allowed every two hours had significantly lower pain scores and less interference from pain with mood, appetite, sleep, physical therapy, and general activity compared to the control group of patients receiving one or two tabs of 5 mg oxycodone every four hours.

More frequent dosing provides better pain control

A comparison of approaches for maintaining peak plasma analgesic levels would be the use of oral oxycodone given in the traditional four-hour route PRN as compared to a two-hour PRN dosing interval using the MOD[®] device. Oral oxycodone is used as an example for dose rate comparisons as it is the most commonly prescribed PRN pain medication in cancer patients (Rosati, Thomas, Buffington, & Conley, 2006) and a frequent choice for oral pain medication following inpatient surgical procedures (Rothwell, et al., 2011).



Liukas, et al. (2008), reported the plasma half-life of oxycodone after oral administration from 3 to 6 hours with an average of $4.8 \pm .03$ hours, depending upon the age of the individual from ages 20 to 90 years. The time to peak analgesic effect is 30 to 60 minutes with a one-compartment or first-order kinetic linear rate of elimination from the plasma (Staahl, et al., 2008; Brunton, Lazo & Parker, 2006).

A linear assumption model in Figure 1 shows the relative relationship between various dosing regimens given at specific time intervals using published data to demonstrate the expected approximate plasma concentrations of total plasma oxycodone in ng/ml.

Figure 1 reveals the sharp peaks and troughs when oxycodone 10 mg is administered every 4 hours prn. Clinically, this results in good initial analgesia with a rapid fall off to subtherapeutic levels by the end of 4 hours. However with an oral loading dose of 10 mg followed by an allowed 5 mg every two hours, plasma levels rise rapidly and appear to remain in the therapeutic range a larger percentage of time due to the increased frequency of dosing. This approach more closely mimics an intravenous administration and a closer approximation to the steady state analgesic levels without the deep peaks and troughs seen with less frequent dosing.

A two-hour dosing interval would be unrealistic with the manual delivery of medication by nursing staff, but the use of the MOD[®] device at the bedside enables the patient to obtain the medication on time more frequently. The total amount of medication used would likely be the same or less since, at the end of each four-hour period, the patient is allowed to take a total of 10 mg of oxycodone.

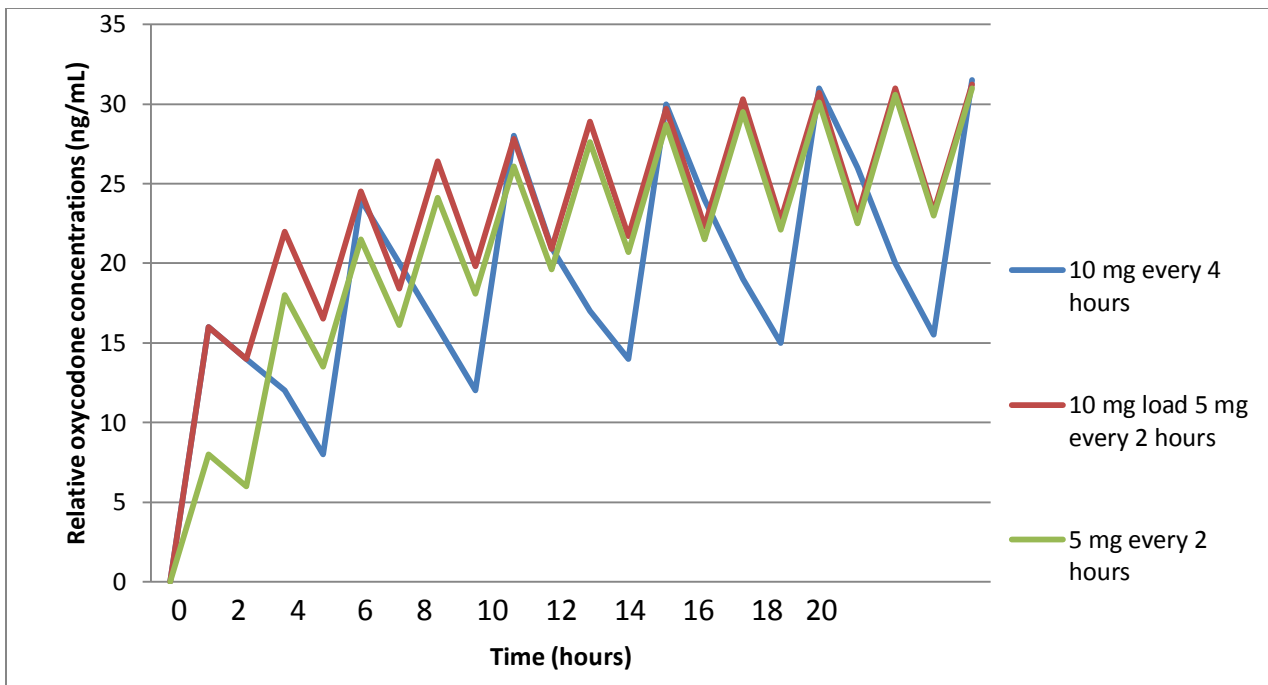


Figure 1 – Depiction of plasma levels of oral oxycodone immediate release with a four-hour half-life

This principle would apply to any oral pain medication dosing regimen comparing the traditional time interval between doses to the two-hour time interval with the MOD[®] device. This shorter time interval between doses is similar to the rationale of the IV-PCA device when it first came into use. At that time medication was frequently given in IM (intramuscular) doses every four hours. With the advent of the IV-PCA device, small intravenous doses of opioids given with short lockout time intervals were found to be more effective for pain management since patients could obtain medication more frequently and regulate their own analgesic dosing more effectively (White, 1988). This same rationale applies to the MOD[®] device by which patients can obtain oral pain medications more frequently and titrate the dose to their own analgesic needs.

The MOD[®] device provides a single dose (tab) of medication after each lockout period. Allowing a dose every two hours provides two tabs if needed within a four-hour time interval, which is equivalent to many dosing regimens in current use. However, by spreading out the medication over shorter time intervals, a more even blood level is achieved without the sharp peaks and troughs with less frequent dosing.

Conclusion

Patient-controlled analgesia (PCA), whatever the delivery method (intravenous, epidural, peripheral nerve block), has always been the evidence-based superior approach for acute pain management compared to the manual delivery of medication. With the advent of the Medication on Demand (MOD[®]) oral PCA device, there is now a solution for the optimal PRN delivery of oral pain medication as it becomes more important in the scheme of multimodal pain management for surgical patients.

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