

Evaluating the Implementation of a Preemptive, Multimodal Analgesia Protocol in a Plastic Surgery Office

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Many patients undergoing plastic surgery experience significant pain postoperatively. The use of preemptive, multimodal analgesia techniques to reduce postoperative pain has been widely described in the literature. This quality improvement project evaluated the implementation of a preemptive, multimodal analgesia protocol in an office-based plastic surgery facility to decrease postoperative pain, decrease postoperative opioid consumption, decrease postanesthesia care time, and increase patient satisfaction. The project included adult patients undergoing surgical procedures at an outpatient plastic and cosmetic surgery office, and the protocol consisted of oral acetaminophen 1,000 mg and gabapentin 1,200 mg. Using a pre-/postintervention design, data were collected from patient medical records and telephone interviews of patients receiving the standard preoperative analgesia

regimen (preintervention group: $n = 24$) and the evidence-based preemptive, multimodal analgesia protocol (postintervention group: $n = 23$). Results indicated no significant differences between the pre- and postintervention groups for any of the outcomes measured. However, results showed that patients in both groups experienced moderate to severe pain postoperatively. In addition, adverse side effects such as dizziness and drowsiness were higher in the postintervention group than in the preintervention group. Although this quality improvement project did not meet the goals it set out to achieve for patients undergoing plastic surgery, it did illustrate the substantial presence of pain after surgical procedures. Thus, clinicians need to continue to focus on identifying targeted treatment plans that use multimodal, non-opioid-based strategies to manage and prevent postoperative pain.

Moderate to severe pain after surgery is experienced by 86% of surgical patients (Apfelbaum, Chen, Mehta, & Gan, 2003). Of these patients, 75% report that this pain occurs after discharge (Apfelbaum et al., 2003). Pavlin, Chen, Penaloza, and Buckley (2004) observed that 60% of ambulatory surgery

patients experienced moderate ($>3/10$) pain and 20% experienced severe ($>7/10$) pain at 24 hr after discharge. One of the most important predictors of pain severity is the type of surgery performed (Chung, Ritchie, & Su, 1997; Pavlin, Chen, Penaloza, Polissar, & Buckley, 2002). Patients undergoing plastic surgery experience severe

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pain postoperatively, with liposuction and breast augmentation procedures being the most painful (Chung et al., 1997; Pavlin et al., 2002).

Severe pain contributes to a longer duration of stay in the postanesthesia care unit (PACU), delayed discharge, unanticipated hospital admissions, and patient dissatisfaction (Chung et al., 1997). Undermanaged postoperative pain causes numerous adverse systemic effects encompassing multiple organ systems, resulting in harmful physiological consequences (Prabhakar et al., 2014). Inadequately treated pain also causes decreased mobility after surgery, leading to complications such as venous thromboembolism and pneumonia (Devin & McGirt, 2015).

Historically, opioid analgesics are the first-line medications for treatment of postoperative pain; however, there is significant evidence that opioid analgesics are associated with numerous adverse side effects such as respiratory depression, nausea, vomiting, and sedation (Devin & McGirt, 2015; Zukowski & Kotfis, 2012). These negative side effects can lead to delayed discharge, prolonged recovery, and patient dissatisfaction (Elvir-Lazo & White, 2010; Zukowski & Kotfis, 2012).

Both The Joint Commission and the American Society of Anesthesiologists (ASA) have recognized the detrimental consequences of postoperative pain and the necessity to develop standards and guidelines addressing pain management using evidence-based, preemptive, multimodal analgesic therapies (ASA, 2012; Devin & McGirt, 2015). Multimodal analgesia refers to the use of a combination of opioid and nonopioid medications with differing mechanisms of action that attenuate pain pathways in the central and peripheral nervous systems producing analgesia (Elvir-Lazo & White, 2010). Preemptive analgesia refers to administration of analgesic medications as an antinociceptive treatment to prevent central sensory processing of afferent neuronal input resulting from a painful stimulus (Ong, Lirk, Seymour, & Jenkins, 2005). The central sensitization caused by incisional and inflammatory mediators produces amplification of nociceptive signals, resulting in hyperalgesia and allodynia (Prabhakar et al., 2014). Thus, preemptive analgesia prevents this central sensitization and decreases the incidence of hyperalgesia and allodynia postoperatively (Ong et al., 2005; Prabhakar et al., 2014).

Preemptive, multimodal analgesia techniques mitigate postoperative pain and reduce postoperative opioid consumption (ASA, 2012; Devin & McGirt, 2015; Low & Gan, 2014; Morgan & Stanik-Hutt, 2015; Ong et al., 2005; Penprase, Brunetto, Dahmani, Forthoffer, & Kapoor, 2015). Numerous studies have also described the efficacy of 2 common agents, gabapentinoids and acetaminophen, used in these types of analgesia regimens (ASA, 2012; De Oliveira, Castro-Alves, & McCarthy, 2015; Devin & McGirt, 2015; Doleman, Heinink, et al., 2015; Doleman, Read, Lund, & Williams, 2015; Low & Gan, 2014; Penprase et al., 2015). To enhance the quality of care

delivered to patients and improve patient outcomes, we implemented a quality improvement (QI) project at an office-based plastic surgery facility. The practice change involved adding gabapentin to the current analgesia plan used at the facility and aimed to decrease postoperative pain, decrease postoperative opioid consumption, decrease recovery time in the PACU, and increase patient satisfaction.

METHODS

Design

The project utilized a pre-/postintervention design. The preintervention group received the standard regimen of 1,000 mg of oral acetaminophen preoperatively. The postintervention group received the new evidence-based, preemptive, multimodal analgesic regimen of 1,000 mg of oral acetaminophen and 1,200 mg of oral gabapentin.

Organizational Setting

This project was conducted in an outpatient office-based plastic and cosmetic surgery facility located in the Research Triangle region of central North Carolina serving a population of approximately 2,253,499. The community-based practice is owned and operated by a board certified plastic surgeon. The procedures offered at this office-based surgery facility included facial, breast, body, and reconstructive surgical procedures. Approximately four to five surgical procedures are performed at the facility every week. The staff includes three registered nurses (RNs), two certified registered nurse anesthetists (CRNAs), a medical assistant, an office manager, and a patient coordinator.

Sample

The convenience sample included all patients scheduled to undergo surgical procedures at the outpatient office-based plastic and cosmetic surgery facility. Inclusion criteria consisted of English-speaking adults 18 years or older with ASA classifications I or II, indicating no significant systemic diseases or risk factors for surgery. The sample excluded patients with hypersensitivity to acetaminophen or gabapentin, history of opioid abuse or chronic opioid use greater than 3 months, renal insufficiency, liver disease, or patients refusing the medications. A G*Power analysis estimated a target sample size of 46 for the project. To get this sample size, we used G*Power, with power set to 0.95, α set to .05, and effect size set to 0.25 (small).

Implementation

The QI innovation involved adding gabapentin to the current preoperative analgesia regimen in order to create an evidence-based, preemptive, multimodal pain

protocol. In the preoperative area, patients were given analgesic medications by staff RNs. The time of medication administration averaged 24–26 min prior to surgery. Patients were also interviewed and assessed by the CRNA provider and the physician during this time. During the intraoperative phase, the RNs, CRNA, and the physician carried out standard patient care practices. Patients received similar intraoperative medications based upon their specific needs and health history, which included midazolam, fentanyl, propofol, ketamine, morphine, ketorolac, and dexamethasone. No long-acting opioids were given during the perioperative period. In the postoperative area, RNs monitored anesthesia recovery, assessed pain scores, and observed for adverse events. Patients were discharged home upon meeting criteria related to the surgery and level of postoperative pain and receiving the physician's order. Staff RNs documented all patient health information on standard medical records used by the office-based surgery facility.

Prior to initiation of the QI project, Duke University institutional review board exemption was obtained. Prospective data collection began in June 2016 on patients in the preintervention group who received preoperative oral acetaminophen 1,000 mg. Once half of the approximate target sample size was reached, data collection ceased. Registered nurses were then notified to begin administering oral acetaminophen 1,000 mg and gabapentin 1,200 mg preoperatively to all further eligible patients. Prospective data collection resumed for patients in the postintervention group who received the preemptive, multimodal analgesic protocol until the other half of the approximate target sample was reached in February 2017.

Data collection methods were identical for both groups. Postoperative Day 0 (POD0) was considered the day of surgery, and postoperative Days 1 and 2 were considered Days 1 and 2, respectively. On postoperative Day 2 (POD2), patients were telephoned and asked to participate in a short survey regarding their postoperative experience. Patients were notified that their participation was strictly voluntary and all responses were completely anonymous. Patient responses were recorded in a password-protected, secured spreadsheet. Perioperative data were then collected from the medical records of patients who had participated in the telephone interview. This information was recorded and stored in the same password-secured spreadsheet.

During both phases of the project, a letter was added to information packets received by patients during their preoperative appointments. This letter included information about the QI project and POD2 telephone interview, noting that participation in the telephone interview was completely voluntary with all responses remaining anonymous. The goal of presenting this information was to encourage and increase patient participation in the follow-up survey.

Outcome Measures

Assessment measures for the QI project included patient age, gender, ASA status, duration of surgery, type of surgery, intraoperative medications and doses, blood loss, PACU arrival and discharge times, and postoperative pain scores on arrival to the PACU and every 15 min until discharge home using the validated 0–10 numeric rating scale (NRS; Devin & McGirt, 2015). These data were obtained from the perioperative medical records.

The POD2 telephone survey contained 12 questions and was created specifically for this QI project. Currently, there are no validated survey tools available to address the specific outcomes of this project. However, numerous validated survey tools were referenced to assist with its formation (Barnett et al., 2013; Bauer, Bohrer, Aichele, Bach, & Martin, 2001; Capuzzo et al., 2005; Jjala, Caljouw, Bedforth, & Hardman, 2010; Schiff et al., 2008). POD2 survey questions included the following: postoperative Day 1 (POD1) pain score using the 0–10 NRS; POD2 pain score using the 0–10 NRS; occurrence of nausea, vomiting, dizziness, or drowsiness within 24 hr after surgery (Y/N); number of opioid analgesic pills consumed on POD0, POD1, and POD2; and patient satisfaction using a Likert-type scale (1, very dissatisfied; 2, dissatisfied; 3, slightly dissatisfied; 4, slightly satisfied; 5, satisfied; 6, very satisfied) assessing satisfaction with pain control after surgery, pain control and comfort upon leaving the office after surgery, and overall care at the office. The POD1 and POD2 pain scores included only one pain score for each day as reported by the patient. Patients were prescribed acetaminophen/oxycodone (Percocet) 325/5 mg one to two pills every 4–6 hr for postoperative analgesia. Therefore, the stated number of pills taken per day by the patient was collected.

RESULTS

Data analysis was conducted on a total of 47 participants, 24 participants in the preintervention group and 23 participants in the postintervention group. Only patients who received the preoperative analgesics and participated in the POD2 telephone survey were included in the analysis. Independent *t* tests and Fisher's exact tests were used to compare demographic and perioperative variables age, gender, ASA status, type of surgery, and duration of surgery for the pre- and postintervention groups. The population was predominantly female (93.6%), with ages ranging from 21 to 87 years. There were no significant differences in demographic and perioperative characteristics between the groups with respect to age, duration of surgery, duration of PACU stay, gender, ASA classification, and type of surgery (Table 1).

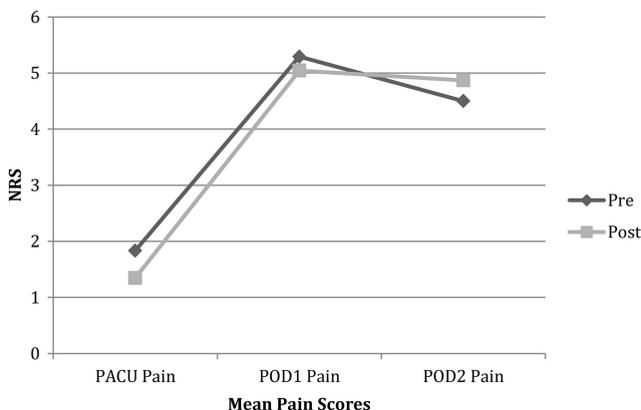
To determine whether postoperative pain decreased with the addition of gabapentin to the analgesic regimen, a mixed-models analysis of variance (ANOVA)

TABLE 1 Demographic and Perioperative Characteristics of Plastic Surgery Patients Receiving Different Analgesia Regimens

	Preintervention (<i>n</i> = 24)	Postintervention (<i>n</i> = 23)	<i>p</i>
Age (years)	44.8 ± 14.9	44.8 ± 10.3	.999
Duration of surgery (min)	136.9 ± 71.8	130.8 ± 46.3	.730
PACU stay (min)	35.9 ± 8.7	36.4 ± 12.2	.857
Gender			
M/F	2/22	1/22	.999
ASA classification			
I/II	10/14	11/12	.773
Type of surgery			
H&N/B/A/C/L	3/12/2/6/1	2/11/4/5/1	.91

Note. A = abdominal; ASA = American Society of Anesthesiologists; B = breast; C = combination; H&N = head and neck; L = liposuction; PACU = postanesthesia care unit.

using pre/postintervention design as the between-groups factor and pain scores at the three time points (PACU, POD1, and POD2) as the within-groups factor was conducted. Results indicated that there were no significant main effect of group (pre vs. post) with regard to pain scores at any time point, $F(1, 45) = 0.07$, $p = .559$ (Figure 1). However, there was an overall significant difference in pain scores between the three time points, $F(1, 45) = 0.07$, $p < .0001$. Thus, follow-up paired *t* tests were conducted to evaluate pain scores across the three time points. These tests found that PACU pain scores were significantly lower than POD1 and POD2 pain scores ($p < .0001$), but POD1 and POD2 pain scores were not significantly different ($p = .086$) (Figure 1). To evaluate whether relationships existed between the type of surgery and pain scores across all time points, a Kruskal–Wallis test was performed. The results showed no differences between pain scores and type of surgery at any of the time points (PACU, POD1, or POD2; all p s $> .05$) in the two groups

**FIGURE 1.** Mean pain scores of plastic surgery patients receiving different analgesia regimens over time.

Descriptive analysis of patient-reported pain scores revealed that patients experienced moderate (4–6 NRS) and severe (7–10 NRS) pain postoperatively. In the PACU, a majority of patients in both groups reported no pain, with 54.2% in the preintervention group and 56.5% in the postintervention group (Table 2). However, on POD1, 58.3% and 20.8% of patients in the preintervention group experienced moderate and severe pain, respectively (Table 2). On POD1, patients in the postintervention group also reported experiencing moderate (47.8%) and severe (30.4%) pain (Table 2). On POD2, the incidence of moderate and severe pain persisted and the majority of patients in both groups experienced these significant pain levels (see Table 2).

A mixed-models ANOVA was conducted to assess whether the addition of gabapentin decreased opioid consumption after surgery. The results showed no difference between the number of opioid analgesic pills consumed in the pre- and postintervention groups, $F(1, 45) = 0.002$, $p = .961$. But the number of pills consumed significantly increased from POD0 to POD1 ($p < .001$) and significantly decreased from POD1 to POD2 ($p < .001$) in both groups. Pearson *r* correlations were performed to identify relationships between pain scores in the PACU, on POD1 and POD2, and the number of opioid analgesic pills taken on POD0, POD1, and POD2 for pre- and postintervention groups and the total sample. There was a positive correlation between pain scores in the PACU and the number of pills consumed on POD0 ($r = .29$, $p < .05$), pain scores on POD1 and pills consumed on POD1 ($r = .46$, $p < .01$), and pain scores on POD2 and the number of pills consumed on POD2 ($r = .44$, $p < .01$) for the total sample.

To evaluate whether recovery time in the PACU decreased and patient satisfaction increased between the two groups, we performed independent *t* tests. The

TABLE 2 Pain Score Percentages Reported by Plastic Surgery Patients Receiving Different Analgesia Regimens

Pain Scores	Preintervention (n = 24)	Postintervention (n = 23)
PACU		
No pain	13/24 (54.2%)	13/23 (56.5%)
Mild	5/24 (20.8%)	6/23 (26.1%)
Moderate	5/24 (20.8%)	3/23 (13%)
Severe	1/24 (4.2%)	1/23 (4.3%)
POD1		
No pain	0/24 (0%)	0/23 (0%)
Mild	5/24 (20.8%)	5/23 (21.7%)
Moderate	14/24 (58.3%)	11/23 (47.8%)
Severe	5/24 (20.8%)	7/23 (30.4%)
POD2		
No pain	0/24 (0%)	1/23 (4.3%)
Mild	10/24 (41.7%)	4/23 (17.4%)
Moderate	8/24 (33.3%)	13/23 (56.5%)
Severe	6/24 (25%)	5/23 (21.7%)

Note. Pain scores defined as follows: no pain (0 NRS); mild (1–3 NRS); moderate (4–6 NRS); and severe (7–10 NRS). NRS = numeric rating scale; PACU, postanesthesia care unit; POD, postoperative day.

results showed that the mean length of PACU stay was 36 min, and there was no difference in this recovery time between the two groups (see Table 1). For the three patient satisfaction measures, pain control after surgery ($p = .423$), pain control and comfort upon leaving the office after surgery ($p = .073$), and overall care at the office ($p = .492$), there were no significant differences between pre- and postintervention scores. However, mean scores show that patients were “very satisfied,” with all three measures in both groups (all $M_s \geq 5.5$). Fisher’s exact tests were conducted to assess differences in the occurrence of adverse effects between groups. Results showed no differences in the occurrence of patient-reported adverse effects such as nausea ($p = .547$), vomiting ($p = .666$), dizziness ($p = .341$), and drowsiness ($p = .193$) between groups. But adverse side effects such as dizziness and drowsiness were 67% and 32% higher in the postintervention group than in the preintervention group, respectively.

DISCUSSION

This QI project was unable to demonstrate the effectiveness of an evidence-based, preemptive, multimodal analgesic protocol as compared with a single-agent preoperative pain regimen. Postoperative pain scores were

unexpectedly similar in both groups, which is inconsistent with multiple studies showing that gabapentin decreases postoperative pain when used in a preemptive, multimodal regimen (Doleman, Heinink, et al., 2015; Kazak, Mortimer, & Sekerci, 2010; Turan et al., 2004). The results, however, did illustrate that all patients experienced moderate to severe pain 24 and 48 hr after surgery, which supports existing evidence of the prevalence of postoperative pain (Chung et al., 1997; Gramke et al., 2007; Pavlin et al., 2002, 2004). Our data also indicated that participants had significant pain no matter what type of surgical procedure was being performed. These results are not consistent with literature showing that the type of surgery is a significant indicator of pain severity (Chung et al., 1997; Pavlin et al., 2002, 2004). This suggests that patients undergoing any type of plastic surgery are at risk for postoperative pain; thus, all patients should be treated with adequate analgesia.

Implementation of the evidence-based regimen did not decrease postoperative opioid consumption, as demonstrated by multiple studies (Arumugam, Lau, & Chamberlain, 2016; Doleman, Heinink, et al., 2015). Our data suggest that those who are experiencing more pain are taking more opioid pain medication across all time points. Because the data also suggest that the severity of pain is trending down on POD2, this could explain the subsequent decrease in POD2 opioid consumption. Because of the overuse of opioids in the United States, it is necessary to reduce or eliminate the requirement for postoperative opioids.

According to a recent national survey, more than 2 million people in the United States are addicted to prescription opioids and more than 12 million have acknowledged misusing them (Murthy, 2016). Surgeons and anesthesia providers have contributed to this rise in opioid use by prescribing larger amounts of opioids than necessary or prescribing opioids in situations where nonopioid analgesics would be effective for controlling postoperative pain (Wick, Grant, & Wu, 2017). Multimodal analgesic regimens and techniques consisting of nonopioid agents have proven to be effective and are ideal for targeting this opioid epidemic. Evidence suggests that the use of acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentinoids, *N*-methyl-*D*-aspartate receptor antagonists, cyclooxygenase-2 selective NSAIDs, local anesthetics, α -2 agonists, and glucocorticoids in a multimodal protocol reduces postoperative pain and narcotic requirements (ASA, 2012; Devin & McGirt, 2015; Low & Gan, 2014; Wick et al., 2017). One opioid-sparing technique that has emerged recently is the enhanced recovery after surgery pathway, which utilizes a nonopioid, multimodal strategy (Wick et al., 2017). Although the literature strongly supports multimodal analgesia, currently there is no evidence specifying a particular regimen. Therefore, more research needs to be conducted to

identify effective pain management practices using multimodal, non-opioid-based analgesics.

Current evidence suggests that preemptive use of gabapentin causes a decreased level of consciousness, leading to a longer stay in the PACU (Siddiqui et al., 2017). Doleman, Heinink, et al. (2015) and Arumugam et al. (2016) also found that preoperative gabapentin increased postoperative sedation, which could lead to recovery delays. This QI project did not decrease or increase PACU recovery time. However, our results demonstrated a clinical trend of higher adverse side effects such as dizziness and drowsiness in the postintervention group than in the preintervention group with the addition of preemptive gabapentin. Standard-of-care practices at the office-based surgery facility require patients to be kept in the PACU until meeting discharge criteria, which is typically within 30–45 min. Because the average PACU length of stay was similar to standard-of-care practices, it is unlikely this QI project would have significantly affected recovery time.

Patient satisfaction and quality of life are among the most important outcomes in plastic surgery (Pusic, Lemaine, Klassen, Scott, & Cano, 2011). Evidence shows that patients undergoing ambulatory surgery prefer to avoid pain, nausea, and vomiting postoperatively (Jenkins et al., 2001). Evaluation of patient satisfaction in plastic surgery patients mostly focuses on aesthetic and general satisfaction, surgical outcomes, physician–patient relationships, and office environment characteristics (Chung, Hamill, Kim, Walters, & Wilkins, 1999). These satisfaction outcomes did not relate to the measures being evaluated by this project. Currently, there is a lack of evidence on patient satisfaction and its relationship to outcomes in plastic surgery; still, patient feedback is crucial because surgeons rely heavily on referrals and return customers (Cohen, Myckatyn, & Brandt, 2017). The addition of gabapentin to the preemptive analgesia protocol did not increase patient satisfaction, contrary to the findings of another study (Doleman, Heinink, et al., 2015). However, patients were already highly satisfied with their postoperative pain control and overall care received at the facility; thus, it was unlikely that scores would have significantly increased.

LIMITATIONS

This QI project contained a small sample size, possibly explaining why statistical significance was not achieved for any of the outcome measures. Although the minimum required sample size was met for the project, a larger sample size would likely yield a better representation of the population. Because of the type of setting, patients were discharged home postoperatively, requiring a telephone follow-up interview to assess outcome measures. Thus, there was potential for inaccurate measurements of outcome measures including postoperative opioid

consumption. Unfortunately, there is no validated survey or patient satisfaction tools addressing the needs of this project at this time. However, validated survey tools were referenced during creation of the POD2 telephone survey and Likert-type scale satisfaction questions were used to enrich the data obtained from participants. The results attained from this QI project are not generalizable to all patients or surgical populations and support the need for further research.

CONCLUSION

Implementation of evidence-based practices seeking to improve patient outcomes and enhance quality of care is critical in today's health care industry. Although the project was unable to meet these aims, it did illustrate that patients undergoing plastic surgery continue to experience significant pain postoperatively.

Although there is strong evidence supporting the use of preemptive, multimodal analgesic regimens, the addition of gabapentin may not be beneficial for this particular population when considering the risk of adverse effects. An increase in the occurrence of negative side effects such as dizziness and drowsiness could increase costs and decrease patient satisfaction. Further evidence is required to determine the efficacy of preemptive gabapentin and acetaminophen in the office-based plastic surgery population.

Postoperative pain is a chief concern of health care organizations, making it an important outcome measure. Opioid dependence is a significant problem that must be addressed by health care providers. Opioid medications are often prescribed for patients after surgery; however, they are not the only analgesics known to be effective for decreasing postoperative pain. Therefore, clinicians need to continue exploring non-opioid-based, multimodal treatment strategies aimed at reducing postoperative pain. These may include approaches that are not within the current standards of care.

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