Patterns and predictors of outpatient opioid use after cytoreductive surgery with hyperthermic intraperitoneal chemotherapy

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ABSTRACT

Background: Long-term opioid use is a well-known complication after surgery. In this retrospective study of adults who had undergone cytoreductive surgery with hyperthermic intraperitoneal chemotherapy (CRS-HIPEC), we sought to determine the rates and factors associated with outpatient opioid use within the sixth and twelfth postoperative months.

Methods: Records of 288 opioid-naïve patients were included. Logistic regression models were used to determine factors prognostic of outpatient opioid use.

Results: The median patient age was 54 years, and 63% were female. Rates of outpatient opioid use within the sixth and twelfth postoperative months were 21 and 13%, respectively. In the multivariate analysis, every doubling in the amount of in-hospital postoperative opioid consumption was associated with a 44% increase in odds of opioid use within the sixth postoperative month (OR 1.44, 95% CI 1.11–1.87, p = .006) and a 70% increase within the twelfth postoperative month (OR 1.70, 95% CI 1.70–2.37, p = .001). Other factors associated with opioid use within the sixth postoperative month included physical status (OR 5.26, 95% CI 1.08–25.55, p = .039) and recent additional surgery (OR 23.02, 95% CI 2.03–261.30, p = .011). Age (OR 4.39, 95% CI 1.77–10.89, p = .001) and tumor grade (OR 3.31, 95% CI 1.31–8.41, p = .012) were associated with opioid use within the twelfth postoperative month.

Conclusion: In this study, the amount of in-hospital postoperative opioid consumption was an important contributory factor to outpatient opioid use in the sixth and twelfth postoperative months.

SYNOPSIS

- In this study of adults who had undergone CRS-HIPEC, higher postoperative opioid consumption during hospitalization was associated with higher odds of opioid use within the sixth and twelfth postoperative months.

Introduction

The current opioid epidemic in the United States has prompted research into the patterns of opioid use among various subgroups of patients [1–3]. In no subgroup is this more essential than in cancer patients, where opioids remain the preferred drug for the treatment of cancer-related pain [3,4].

Among abdominal surgeries, cytoreductive surgery with hyperthermic intraperitoneal chemotherapy (CRS-HIPEC) is unique in its magnitude and degree of associated tissue injury [5,6]. Although opioids have traditionally formed the cornerstone for pain management in patients who undergo CRS-HIPEC [7,8], little is known about the patterns of opioid use beyond the immediate postoperative period in this patient population. Similarly, there is a lack of information about the factors that influence the need for opioid use after discharge. Identification of such factors could be useful in reducing the risk of prolonged opioid use in this patient population.

In this retrospective study of patients who had undergone CRS-HIPEC for the treatment of carcinomatosis of appendiceal origin, our objectives were twofold. First, we sought to describe the rates of outpatient opioid use within the sixth and twelfth postoperative months. We chose these time points because published reports suggest ‘normal recovery’ after CRS-HIPEC can take up to 6 months [9,10]. Second, we sought to determine which perioperative factors were associated with outpatient opioid use within the sixth and twelfth postoperative months. Based on previous reports [1–3], we hypothesized that opioid use within the sixth and twelfth postoperative months would be associated with disease-related factors and/or perioperative opioid exposure.

Methods

This retrospective study was approved by the Institutional Review Board of The University of Texas MD Anderson...
Cancer Center (IRB No. PA 14-1087). Medical records of all adult patients (≥19 years old) who were discharged after undergoing CRS-HIPEC between January 2006 and July 2018 were reviewed. Patients who had undergone repeat CRS-HIPEC and those who were using opioids within the 30 days before surgery were excluded. Preoperative data including basic demographic information, neoadjuvant therapies, American Society of Anesthesiologists (ASA) physical status score and smoking history were recorded. Intraoperative variables included anesthesia duration, intraoperative opioid administration in intravenous morphine equivalents, peritoneal carcinomatosis index (PCI) and completeness of cytoreduction (CC) scores, intraperitoneal chemotherapy agent and tumor grade. In-hospital postoperative opioid consumption (immediate postoperative period to day of hospital discharge), length of stay, high-grade complications (Clavien-Dindo ≥ 3) [11], disease progression, pain scores at the 6- and 12-month postoperative visits, additional surgeries within the sixth and twelfth postoperative months and patient-reported outpatient opioid use (yes/no) within the sixth and twelfth postoperative months were also recorded.

**Anesthetic and pain management**

Anesthetic management evolved over the 12-year study period and was not standardized at any point. Between January 2006 and November 2011, anesthetic management generally consisted of opioid-based volatile anesthesia plus epidural analgesia. After November 2011, there was a gradual introduction of multimodal analgesic approaches into the anesthetic regimen. This included the preoperative administration of celecoxib (200–400 mg), tramadol ER (300 mg) and pregabalin (30–150 mg), followed by intraoperative opioid-sparing total intravenous anesthesia with propofol (50–150 μg/kg/min), dexmedetomidine (0.3 μg/kg/h), ketamine (10 mg/h) and lidocaine (2 mg/min). In some patients, volatile anesthetic agents were used in combination with components of multimodal analgesia. The use of epidural analgesia has continued. However, a significant number of transversus abdominus plane blocks with liposomal bupivacaine have been used as well.

In patients with an epidural catheter, postoperative pain management has evolved from traditional epidural analgesia with supplemental opioid-based patient-controlled analgesia to include scheduled doses of acetaminophen, tramadol, celecoxib and gabapentinoids in select patients. In the immediate postoperative period, epidural analgesic infusions consisting of bupivacaine (0.075%) with fentanyl (2–5 mcg/ml) or hydromorphone (2–10 mcg/ml) are used for pain control. Epidural analgesic infusions are typically initiated at a continuous rate of 8 ml/h with a patient controlled bolus of an additional 3 ml every 10 min as needed. In the event of inadequate pain control, supplemental intravenous opioid-based patient controlled analgesia (IVPCA) with either morphine, hydromorphone or fentanyl is introduced.

For morphine-based IVPCA, continuous infusion doses of up to 4 mg/h, patient administered boluses of up to 2 mg, with a lockout interval of 6–15 min is typically utilized. Hydromorphone-based IVPCA is typically administered at a continuous infusion rate of up to 0.6 mg/h, with patient administered boluses of 0–0.5 mg at lockout intervals of between 6 and 15 min. Continuous infusion doses of fentanyl-based IVPCA range from 0 to 50 mcg/h, with patient administered boluses of 0–25 mcg and a lockout interval of 6–15 min. IVPCA regimens are typically supplemented with scheduled doses intravenous acetaminophen. Later in the postoperative period, non-opioid oral adjuncts (tramadol, celecoxib and gabapentinoids) are introduced when nasogastric tubes are removed, and oral feedings are tolerated.

Precluding any contraindications, patients who received transversus abdominus plane blocks with liposomal bupivacaine are routinely administered hydromorphone-based IVPCA as described above. Similar to patients receiving epidural analgesia, the routine presence of a nasogastric tube in the immediate postoperative period limits the use of non-opioid oral analgesics to the latter postoperative period.

All postoperative analgesic regimens are adjusted as needed in each patient depending on contraindications, side effects or intolerance. At discharge, pain medications are prescribed by either the surgical team, the acute pain management team, or the physician responsible for managing the patient’s long-term opioid use.

**Statistical analysis**

Patients’ demographics, disease status and clinical outcomes were summarized through descriptive statistics. Logarithmic transformation to base 2 was performed on variables such as opioid consumption, which were not normally distributed. Wilcoxon rank sum tests were used to compare location parameters of continuous distributions between patient groups. The Fisher exact or Chi-square test was used to evaluate associations between patient characteristics and other patient outcomes with opioid consumption status. Multivariate logistic regression models were used to evaluate the effect of important covariates on opioid consumption status at postoperative clinical visits. A backward model selection method was used, and the final model included the covariates with a p values less than .20 in univariate analysis and clinically relevant variables. p values ≤ .05 were considered significant Statistical software SAS 9.4 (SAS, Cary, NC, USA) was used for all the analyses.

**Results**

**Patient characteristics**

Over the study period, 457 CRS-HIPEC procedures were performed for the treatment of appendiceal carcinomatosis. After excluding patients who had previously undergone CRS-HIPEC (n = 25), those who used opioids within the 30 days before surgery (n = 106), and those who did not have an outpatient postoperative visit within the study period (n = 38), we analyzed records of 288 patients.

Of the 288 patients, 63% were women, and the median age (interquartile range [IQR]) was 54 years (45–62). The
majority (66%) had low-grade tumors, and neoadjuvant chemotherapy was used in 30% of the patients. The median PCI (IQR) was 17 (11–25), and a CC score of zero was achieved in most (69%) of the patients. Further details of intraoperative and postoperative management are presented in Table 1.

### Table 1. Demographic and clinical characteristics of opioid-naïve patients who had undergone cytoreductive surgery with hyperthermic intraperitoneal chemotherapy.

| Variable                        | All patients, no. (%) (n = 288) | Patients with appointments within the sixth postoperative month, no. (%) | Patients with appointments within the twelfth postoperative month, no. (%) | p     | p     |
|--------------------------------|---------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------|-------|-------|
|                                | No opioid use (n = 201) | Opioid use (n = 52) | No opioid use (n = 201) | Opioid use (n = 30) | | | |
| Age, years                      |                                |                          |                             |                             | | | |
| <55                             | 115 (84)                       | 22 (16)                  | 111 (93)                    | 8 (7)                       | .058 | .035 |
| >55                             | 86 (74)                        | 30 (26)                  | 90 (80)                     | 22 (20)                     | .824 | .149 |
| BMI                             |                                |                          |                             |                             | | | |
| <25                             | 69 (80)                        | 17 (20)                  | 74 (91)                     | 7 (9)                       | .879 | .426 |
| >25                             | 132 (79)                       | 35 (21)                  | 127 (85)                    | 23 (15)                     | .030 | .066 |
| Gender                          |                                |                          |                             |                             | | | |
| Female                          | 126 (80)                       | 32 (20)                  | 129 (88)                    | 17 (12)                     | .097 | 1.000 |
| Male                            | 75 (79)                        | 20 (21)                  | 72 (85)                     | 15 (13)                     | | | |
| ASA score                       |                                |                          |                             |                             | | | |
| 2                               | 34 (92)                        | 3 (8)                    | 28 (88)                     | 4 (12)                      | .047 | 1.000 |
| 3 or 4                          | 248 (86)                       | 49 (23)                  | 173 (87)                    | 26 (13)                     | | | |
| Neoadjuvant chemotherapy        |                                |                          |                             |                             | | | |
| No                              | 144 (80)                       | 37 (20)                  | 141 (90)                    | 16 (10)                     | .947 | .066 |
| Yes                             | 57 (79)                        | 15 (21)                  | 60 (81)                     | 14 (19)                     | | | |
| Smoking                         |                                |                          |                             |                             | | | |
| No                              | 197 (79)                       | 51 (21)                  | 197 (87)                    | 30 (13)                     | .030 | .066 |
| Yes                             | 4 (80)                         | 1 (20)                   | 4 (100)                     | 0 (0)                       | | | |
| Tumor grade                     |                                |                          |                             |                             | | | |
| High                            | 26 (74)                        | 9 (26)                   | 30 (88)                     | 4 (11)                      | | | |
| Intermediate                    | 41 (79)                        | 11 (21)                  | 37 (77)                     | 11 (23)                     | | | |
| Low                             | 134 (81)                       | 32 (19)                  | 134 (90)                    | 15 (10)                     | | | |
| CC Score                        |                                |                          |                             |                             | | | |
| 0                               | 119 (82)                       | 27 (18)                  | 116 (87)                    | 18 (13)                     | | | |
| 1                               | 41 (79)                        | 11 (21)                  | 44 (92)                     | 4 (8)                       | | | |
| 2                               | 6 (46)                         | 7 (54)                   | 9 (75)                      | 3 (25)                      | | | |
| 3                               | 2 (67)                         | 1 (33)                   | 0 (0)                       | 1 (100)                     | | | |
| PCI, median (IQR)               | 17 (11–25)                     | 23 (14–28)               | 15 (10–24)                  | 18 (13–25)                  | .210 | .227 |
| HIPEC agent                     |                                |                          |                             |                             | | | |
| Cisplatin or oxaliplatin        | 16 (94)                        | 1 (6)                    | 13 (100)                    | 0 (0)                       | | | |
| Mitomycin C                     | 185 (78)                       | 51 (22)                  | 188 (86)                    | 30 (14)                     | | | |
| Any postoperative complications |                                |                          |                             |                             | | | |
| No                              | 75 (87)                        | 11 (12)                  | 71 (89)                     | 9 (11)                      | | | |
| Yes                             | 126 (75)                       | 41 (25)                  | 130 (86)                    | 21 (14)                     | | | |
| High-grade complications        |                                |                          |                             |                             | | | |
| No                              | 177 (82)                       | 39 (18)                  | 71 (89)                     | 9 (11)                      | | | |
| Yes                             | 24 (65)                        | 13 (35)                  | 130 (86)                    | 21 (14)                     | | | |
| Disease progression             |                                |                          |                             |                             | | | |
| No                              | 194 (81)                       | 46 (19)                  | 178 (88)                    | 25 (12)                     | | | |
| Yes                             | 7 (54)                         | 6 (46)                   | 23 (82)                     | 5 (18)                      | | | |
| Anesthesia duration, min, median (IQR) | 597 (510–721) | 657 (565–748) | 597 (509–727) | 641 (535–719) | .230 | .196 |
| Intraoperative opioids, median, MED (IQR) | 65 (15–130) | 40 (13–125) | 65 (16–125) | 50 (15–120) | .047 | .259 |
| Postoperative opioid consumption, median, MED (IQR) | 816 (410–1335) | 1456 (724–2481) | <.001 | 908 (435–1480) | 1317 (619–2585) | .018 | .018 |
| Length of stay, median, days (IQR) | 13 (10–19) | 18 (11–29) | .066 | 14 (10–20) | 18 (11–31) | .047 | .047 |
| Additional surgery within 1 month of postoperative visit | | | | | | | |
| No                              | 46 (19)                        | 198 (87.2)               | 29 (12.8)                   | | | |
| Yes                             | 5 (83)                         | 0 (0)                    | 1 (100)                     | | | |
| Pain score during postoperative visit, NRS | | | | | | | |
| <4                              | 139 (81)                       | 140 (89)                 | 17 (11)                     | | | |
| ≥4                              | 7 (88)                         | 6 (67)                   | 3 (33)                      | | | |

ASA: American Society of Anesthesiologists; BMI: body mass index; CC: completeness of cytoreduction; IQR: interquartile range; MED: intravenous morphine dose equivalents; NRS: numeric rating scale; PCI: peritoneal carcinomatosis index.

**Patient-reported outpatient opioid use within the sixth postoperative month**

Of the 288 patients in the study, 253 (88%) had a ‘6-month’ postoperative visit. Of the patients who had 6-month visits, 52 (21%) reported opioid use. In the univariate analysis
Table 2. Multivariate analysis of factors associated with opioid use at 6 and 12 months after cytoreductive surgery with hyperthermic intraperitoneal chemotherapy.

| Variable                                      | 6 Months after CRS-HIPEC | 12 Months after CRS-HIPEC |
|-----------------------------------------------|--------------------------|---------------------------|
|                                               | OR           | 95% CI        | p   | OR           | 95% CI        | p   |
| Postoperative opioid consumption (log, MED)  | 1.44         | 1.11–1.87    | .006| 1.70         | 1.22–2.37    | .001|
| Age, years, ≥ 55 versus < 55                  | 1.70         | 0.86–3.39    | .130| 4.39         | 1.77–10.89   | .001|
| ASA score, 3 or 4 versus 2                    | 5.26         | 1.08–25.55   | .039| 2.38         | 0.54–11.79   | .300|
| Any postoperative complication                | 1.84         | 0.82–4.12    | .138| 3.31         | 1.31–8.41    | .012|
| Surgery 5 or 6 months after CRS-HIPEC         | 23.02        | 2.03–261.3   | .011| 3.31         | 1.31–8.41    | .012|
| Tumor grade, intermediate versus low          |              |              |     |              |              |     |

ASA: American Society of Anesthesiologists; CI: confidence interval; CRS-HIPEC: cytoreductive surgery with hyperthermic intraperitoneal chemotherapy; MED: intravenous morphine dose equivalents; OR: odds ratio.

(Table 1), opioid use within the sixth postoperative month was associated with in-hospital postoperative opioid consumption (p < .001), higher ASA score (p = .047), incomplete cytoreduction (p = .030), PCI score (p = .012), postoperative complications (p = .028), high-grade postoperative complications (p = .018), disease progression (p = .019), anesthesia duration (p = .023), length of stay (p = .006), additional surgeries within the sixth postoperative month (p = .002) and pain scores during the postoperative visit (p < .001). In the adjusted multivariate model (Table 2), in-hospital postoperative opioid consumption was associated with opioid use within the sixth postoperative month. Every doubling of the amount of in-hospital postoperative opioid consumption was associated with a 44% increase in the odds of opioid use within the sixth postoperative month (odds ratio [OR] 1.44, 95% confidence interval [CI], 1.11–1.87, p = .006). Other factors that were independently associated with opioid use within the sixth postoperative month included ASA score (OR 5.26, 95% CI 1.08–25.55, p = .039) and additional surgery with the sixth postoperative month (OR 23.02, 95% CI 2.03–261.3, p = .011).

**Patient-reported outpatient opioid use within the twelfth postoperative month**

Of the 231 patients who had a ‘12-month’ postoperative visit, 30 (13%) reported opioid use. In the univariate analysis (Table 1), opioid use in the twelfth postoperative month was associated with in-hospital postoperative opioid consumption (p = .018), age (p = .035) and length of stay (p = .047). In the adjusted multivariate model (Table 2), every doubling in the amount of in-hospital postoperative opioid consumption was associated with a 70% increase in the odds of opioid use within the twelfth postoperative month (OR 1.70, 95% CI 1.22–2.73, p = .001). Furthermore, age ≥ 55 years and intermediate-grade tumors were associated with increased odds of opioid use within the twelfth postoperative month (OR 3.31, 95% CI 1.31–8.41, p = .012).

**Discussion**

In this retrospective study of adults who had undergone CRS-HIPEC, the rates of outpatient opioid use within the sixth and twelfth postoperative months were 21 and 13%, respectively. Higher in-hospital postoperative opioid consumption was a significant risk factor for opioid use within the sixth and twelfth postoperative months. To the best of our knowledge, this is the first study to report on opioid use beyond the immediate postoperative period in this patient population.

Opioid use beyond the immediate postoperative period has been shown to be influenced by the type of surgical procedure [2,12]. In general, our observed rates of opioid use at 6 months were higher than those reported after other major abdominal surgeries. For example, in a large database review of patients who had undergone several different major abdominal surgeries, 11% filled an opioid prescription between 3 and 6 months after discharge [13]. In another large database review, 10.8% of patients who underwent major colorectal surgery filled an opioid prescription between 3 and 6 months after surgery [12].

The reasons for the difference in postdischarge opioid use are manifold, but most significant may be the differences in degree of tissue injury and pain associated with different surgical procedures. Peritoneal carcinomatosis is considered a metastatic disease, and CRS-HIPEC involves multiple organ resections and peritonectomies as well as the instillation of heated chemotherapy into the abdominal cavity [14]. Thus, it is conceivable that patients who have undergone CRS-HIPEC might experience significantly higher levels of pain, and require more opioids, than do those who have undergone other oncologic procedures.

The high rate of post-discharge opioid use among patients who have undergone CRS-HIPEC also may be related to the follow-up care that patients receive. Most patients in our study received follow-up care with providers outside our institution. Because appendiceal carcinomatosis is such a rare disease, it is possible that less familiarity with patients who have undergone CRS-HIPEC may have contributed to higher opioid prescription rates.

Unlike the 6-month opioid use rates, for which our findings were almost twice as high as those reported by comparable studies, our reported opioid use rate at 12 months was similar to that of another study of patients who had undergone curative-intent cancer surgery [3]. In that study, Lee and colleagues reported a 10% opioid use rate at 12 months [3]. This similarity in opioid use rates may suggest that by 12 months, patients who had undergone CRS-HIPEC had attained similar levels of recovery as patients who had undergone other major oncologic procedures.

In this study, higher in-hospital postoperative opioid consumption was independently associated with higher odds of opioid use within the sixth and twelfth postoperative months. A similar association was reported in a large...
population-based study of 36,177 patients who had undergone minor or major surgical procedures [1]. In that study, perioperative opioid consumption of $\geq 300$ oral morphine equivalents was associated with a 14% increase in the risk of new persistent opioid use [1]. In our previous study of persistent opioid use after CRS-HIPEC in children, higher levels if in-hospital opioid consumption after surgery was associated with higher odds of persistent opioid use at 6 months [15].

Higher opioid consumption has been associated with the development of acute tolerance and opioid-induced hyperalgesia (OIH) [16,17], both of which may contribute to prolonged opioid use [17,18]. It is currently unclear whether the doses of opioids administered in the immediate postoperative period could lead to the development of acute tolerance or OIH. This is mainly due to limited data and the conflicting nature of available reports [19]. However, both tolerance and OIH have been shown to develop within a month of initiating opioid therapy in chronic pain patients [20]. Furthermore, in a randomized double-blind study of healthy volunteers, the administration of 10 $\mu$g/kg of fentanyl was associated with increased hyperalgesia [21]. Based on these findings, the contribution of postoperatively administered opioids to long-term opioid use cannot be completely ruled out.

Several non-opioid analgesics such as acetaminophen [22], nonsteroidal anti-inflammatory drugs [23], N-methyl-D-aspartate receptor antagonists [24], gabapentinoids [25] and selective cyclo-oxygenase 2 inhibitors [26] have been co-administered to reduce perioperative opioid consumption. However, it is currently unclear whether the perioperative opioid-sparing effects of these non-opioid analgesic adjuncts reduce the risk of prolonged opioid use [27]. Furthermore, outside the perioperative setting, some studies have not demonstrated opioid-sparing effects associated with non-opioid analgesic use [28,29]. For example, in a retrospective study of 78 cancer patients admitted to a palliative care unit, the administration of non-opioid analgesic adjuncts was not associated with reduced opioid consumption or improved pain scores [28]. In another publication describing an interdisciplinary approach to outpatient cancer pain management, an analysis of outcomes could not demonstrate an obvious opioid-sparing effect of non-opioid or non-drug analgesic interventions [29]. In that study, a significant reduction in the consumption of short-acting opioids was accompanied by an increase in the use of long-acting opioids.

Modification of prescription practices has also been suggested as a means of reducing the risk of long-term opioid use [30–32]. In a study that evaluated long-term analgesic use after short-stay surgery [33], it was notable that the rates of prescription opioid use 1 year after surgery were similar between patients who received an opioid prescription at discharge and those who did not (7.7 versus 7.5%). However, after multivariate adjustment, the researchers found that patients who received an opioid prescription at discharge were 44% more likely to become chronic opioid users. These findings underscore the importance of additional measures to reduce the risk of long-term opioid use. The use of validated screening tools in all patients using prescription opioids [34,35], and the targeting of psychosocial issues to combat ‘chemical coping’ [36,37] are examples of additional measures that may be used in conjunction with opioid-sparing approaches.

In this study, age $\geq 55$ years was associated with higher odds of opioid use within the twelfth postoperative month. In previous reports, the association between age and prolonged opioid use has not been consistent [1,3]. For example, in the study by Lee and colleagues [3], older age was associated with lower risk of persistent opioid use in breast cancer patients. However, this association was not observed in patients with melanoma or thoracic, colorectal or hepatobiliary cancers. We speculate that the association between advanced age and opioid use in our study may be related to the higher incidence of musculoskeletal or other chronic pain conditions in older patients [37].

Our study also found that higher ASA score or undergoing an additional surgical procedure within the month of a postoperative visit were independently associated with opioid use within the sixth postoperative month. This finding may be related to higher rates of comorbidity in patients with higher ASA scores and continued wound healing in those who had recently undergone an additional surgical procedure.

It is not entirely clear to us why intermediate-grade tumors were associated with opioid use within the twelfth postoperative month. We speculate that a large proportion of patients with intermediate-grade tumors may have experienced disease progression and thus required opioids for pain control.

This study has some limitations. First, since the majority of our patients received several aspects of follow-up care at other institutions, we did not have reliable data on persistent opioid use and could not report our data as such. However, factors associated with opioid use within the sixth and twelfth months were similar to those associated with the development of persistent opioid use. Second, we did not have information on important predictors of long-term opioid use such as anxiety, catastrophizing scores or drug abuse. Further, the amount of missing data on important variables such as outpatient pain scores and PCI and CC scores was a significant limitation, since these variables could not be included in the multivariate analysis.

Conclusion

In this study of adults who had undergone CRS-HIPEC, the rate of opioid use 6 months after surgery was higher than those reported after other major abdominal surgeries. However, the rate after 12 months was comparable to those of previous reports. Furthermore, higher in-hospital postoperative opioid consumption was independently associated with greater odds of opioid use within the sixth and twelfth months after surgery. Further studies are required to describe the opioid use patterns of patients who have undergone CRS-HIPEC.

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