

Article

Opioid-Free Anaesthesia as a Component of Enhanced Recovery After Surgery (ERAS): Impact on Postoperative Opioid Consumption and Recovery

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Abstract:

Background: The global opioid epidemic has been exacerbated by the growing dependence on perioperative opioids, which has raised interest in opioid-minimizing techniques for Enhanced Recovery After Surgery (ERAS) procedures. Opioid-free anaesthesia (OFA) has emerged as a potential alternative to conventional opioid-based anaesthesia (OBA), yet real-world institutional data comparing these approaches remain limited.

Objectives: This study evaluated the effect of OFA within an established ERAS pathway on postoperative opioid consumption and recovery outcomes

Methods: A single-center retrospective cohort study was conducted including 100 adult patients undergoing elective surgery under a standardized ERAS protocol. Patients were categorized into OFA (n=50) and OBA (n=50) groups based on intraoperative anaesthetic technique. The primary outcome was total opioid consumption within 24 hours postoperatively, expressed as Morphine Milligram Equivalents (MME). Secondary outcomes included postoperative pain scores at 6, 12, and 24 hours, time to ambulation, length of hospital stay (LOS), and correlation analyses. Statistical comparisons were performed using independent t-tests, Pearson correlation, and multiple linear regression.

Results: The OFA group confirmed significantly lower 24-hour opioid consumption compared to OBA ($p < 0.001$). Postoperative pain scores were consistently lower in the OFA group at all time points ($p < 0.001$). Additionally, OFA was associated with earlier ambulation and reduced hospital stay ($p < 0.001$). Anaesthetic technique was identified as the only significant independent predictor of postoperative opioid requirement ($R^2 = 0.43$).

Conclusion: OFA within an ERAS protocol significantly reduces opioid use and enhances early postoperative recovery without compromising analgesia, supporting its role in perioperative opioid stewardship.

Keywords: Opioid-free anaesthesia; Enhanced Recovery After Surgery; Postoperative opioid consumption; Multimodal analgesia; Perioperative recovery

INTRODUCTION

The rise in the use of perioperative opioids across the globe has helped in the further increase in the current opioid crisis, and postoperative prescribing practices have been identified as a leading entry point to opioid dependency. Although effective as an opioid-based method of analgesia, traditional opioid-based anaesthesia (OBA) is linked with numerous side effects like ileus, postoperative nausea, and vomiting (PONV), sedation, respiratory depression, and opioid-induced hyperalgesia which can delay the recovery and increase the length of stay. As a reaction to these fears, focus on opioid-reducing measures in the context of perioperative care has been growing. The development of Enhanced Recovery After Surgery (ERAS) procedures was focused at maximizing postoperative outcomes based on multimodal approaches of minimization of surgical stress, prompt mobilization, and the use of evidence-based analgesic therapy. One of the main pillars of ERAS is the minimization of opioid exposure with multimodal analgesia [1].

In this context, the so-called opioid-free anaesthesia (OFA) has become one of the possible alternatives to the traditional opioid-based methods. OFA also avoids the use of intraoperative opioids and opts to use ketamine, lidocaine, magnesium sulfate, dexmedetomidine, and nonsteroidal anti-inflammatory drugs in combinations to produce sufficient analgesia and hemodynamic stability. Some clinical studies have been represented to understand the efficacy of OFA in different groups of surgeries. OFA was also linked to a considerable decrease in postoperative morphine intake and analgesic control was not lost in bariatric surgery [2]. In the same way, OFA embedded in ERAS pathways have shown to decrease opioid prescriptions at the time of hospital discharge [3]. Systematic evidence of OFA use proposed in oncologic surgery is expected to positively affect postoperative outcomes and reduce adverse opioid effects [4]. In the spinal surgery, comparative studies also reported an increase in the recovery profiles when OFA was used in addition to ERAS protocols [5]. Effectiveness and safety of multimodal opioid-free strategies are also maintained with the help of meta-analytic evidence. A more recent systematic review demonstrated better postoperative pain management and regaining rate in the case of laparoscopic surgery when using OFA [6]. Extensive meta-analysis has indicated that OFA can substantially decrease the number of opioids needed after a specific procedure; this contrasts with the conventional methods [7]. Moreover, new professional approaches refer to OFA as a potential another to opioid-based practices and admit that such practices need to be implemented in a structured way [8]. Future studies of ERAS protocols that use no opioid regimen have shown better perioperative outcomes during urological operations [9]. There is still controversy in orthopedic surgery on whether to achieve opioid removal or sufficient analgesia in the context of ERAS [10]. Overall, the existing literature shows that OFA can potentially decrease the amount of opioid use and improve a recovery process, though its clinical implementation in the existing ERAS programs is the subject of current research.

Although, the main questions remain unanswered as to whether OFA can be implemented on a regular basis in ERAS pathways. The reviews have underscored the potential and practical issues of the opioid-free methods and pointed to the inconsistency in protocols and pharmacologic mixes [11]. An issue of a one-size-fits-all approach has also been raised because patients vary on comorbidities, surgical complexity, and institutional resources [12]. The literature also emphasizes that balance in perioperative analgesia interventions should not be neglected, and full opioid eradication should not occur in the absence of sufficient evidence in different populations [13]. Also, although certain studies have shown that alternative anaesthetic methods lead to decreased opioid consumption during the ERAS pathways, the lack of uniformity of the outcome measures and operating rooms restricts generalizability [14]. The latest meta-analyses assessing the quality of recovery after OFA show encouraging outcomes, however, methods have several limitations, such as the variability of endpoints, short follow-up periods [15]. Accordingly, there is a lack of empirical retrospective studies that measure the extent of opioid reduction and recovery benefits of OFA relative to OBA in the usual implementation of ERAS.

ERAS programs have also shown a substantial decrease in opioid consumption and patient-reported outcomes [16]. At the same time, narrative reviews indicate that opioid-sparing and opioid-free interventions can become a new paradigm of safer and quicker postoperative recovery [17]. Experience of specialized surgical groups such as cardiac surgery suggests that organized ERAS guidelines can significantly decrease opioid use without increasing safety [18]. In addition, the general trend toward non-opioid-based pain management policies shows increased awareness of the necessity of opioid stewardship in the field of perioperative medicine [19]. Nevertheless, institutional level comparative retrospective studies on OFA and OBA in an established ERAS pathway are deficient.

Research Objectives

1. To compare postoperative opioid consumption between patients receiving opioid-free anaesthesia (OFA) and opioid-based anaesthesia (OBA) within an ERAS protocol.
 2. To evaluate differences in postoperative pain scores and quality of recovery between the OFA and OBA groups.
- To assess variations in postoperative outcomes, including incidence of postoperative nausea and vomiting and length of hospital stay, between the two groups.

METHODOLOGY

Study Design and Setting

The research was done in a tertiary care institution as a single-centre retrospective cohort study. The medical records of adult patients who had undergone voluntary surgical procedures according to put in place Enhanced Recovery After Surgery (ERAS) protocol were examined. Ethical approval was obtained in an institution before data was collected and all patient information was anonymized to maintain confidentiality.

Study Population

Total 100 adult patients were identified and divided into two groups, 50 each in the OFA and OBA groups, according to the type of anaesthetics they received. All patients have gone through elective surgery using a unified ERAS pathway that involved multimodal analgesia, optimum perioperative care, early mobilisation and systematic discharge criteria.

Inclusion Criteria

Patients have to be at least eighteen years old, have elective surgery in the institutional ERAS protocol, be classified as I-III physically by the American Society of Anesthesiologists (ASA), and have all of their perioperative and postoperative information available for review to be eligible for inclusion.

Exclusion Criteria

Patients were not considered when they had a past of chronic opioid habit or opioid dependence, had undergone emergency surgical operations, or who needed postoperative admission in the concentrated care unit, or when they lacked or had incomplete clinical documentation.

Anaesthetic Intervention

OFA patients were treated to an opioid-free multimodal intraoperative regimen comprising of dexmedetomidine infusion, ketamine bolus, intravenous lidocaine infusion, magnesium sulfate when necessary, and non-opioid analgesics like paracetamol and NSAIDs, but no intraoperative opioids were used. Conversely, groups with OBA were obtained standard opioid-based anaesthesia, including fentanyl or remifentanyl intraoperative and conventional postoperative opioid analgesia, whilst all other elements of ERAS were equally distributed between the two groups.

Outcome Measures

The main result was the overall consumption of opioids during the 24 hours after the operation, which was transformed into the Morphine Milligram Equivalents (MME) to uniformly compare it. Secondary outcomes were postoperative pain scores based on the VAS at 6, 12 and 24 hours, postoperative nausea, and vomiting (PONV), the first ambulation time, length of stay (LOS) and presence of postoperative complications.

Data Collection

Electronic medical records, anaesthesia charts, and the institutional ERAS registry database (including demographic variables (age, sex, BMI), ASA status, duration of surgery, intraoperative hemodynamic variables, postoperative opioid requirement, pain scores, PONV incidence, time to ambulation, LOS, and complications) were retrospectively retrieved in the data and all of them were anonymized before analysis.

Statistical Analysis

The data extracted were entered into Microsoft Excel. Continuous variables were considered as means + SD instead of quantifiable variables which were in frequencies and percentages. The variables were compared across the groups (i.e., 24-hour opioid use, 6, 12 and 24-hour pain score, time to ambulation, and length of stay) by the independent samples t-test. The correlation between 24-hour opioid use and recovery outcomes was performed through Pearson correlation analysis and the predictors of postoperative opioid use independent of each other were performed through multiple linear regression analysis. A p-value of less than 0.05 was regarded as statistically significant.

RESULTS

Baseline Demographic and Clinical Profile

The research involved 100 patients (50 of each group). The baseline demographic and clinical features are shown in Table 1. There were no statistically significant variances in gender representation, ASA physical status, or BMI category ($p > 0.05$ in all) found a difference in OFA and OBA groups, which proved that the two sets of participants were similar at baseline.

Table 1. Demographic and Clinical profile (n=100)

Category	Variable	OFA	OBA	p-value
Gender	Male	28 (56%)	30 (60%)	0.68
	Female	22 (44%)	20 (40%)	
ASA Status	ASA I	10 (20%)	9 (18%)	0.83
	ASA II	32 (64%)	33 (66%)	
	ASA III	8 (16%)	8 (16%)	
BMI Category	Normal	14 (28%)	12 (24%)	0.74
	Overweight	26 (52%)	28 (56%)	
	Obese	10 (20%)	10 (20%)	

Figure 1 shows the demographic and clinical profile of the OFA and the OBA groups. The figure represents a percentage distribution of gender, ASA physical status classification and BMI categories in both groups that defines a

visual comparison of baseline comparability.

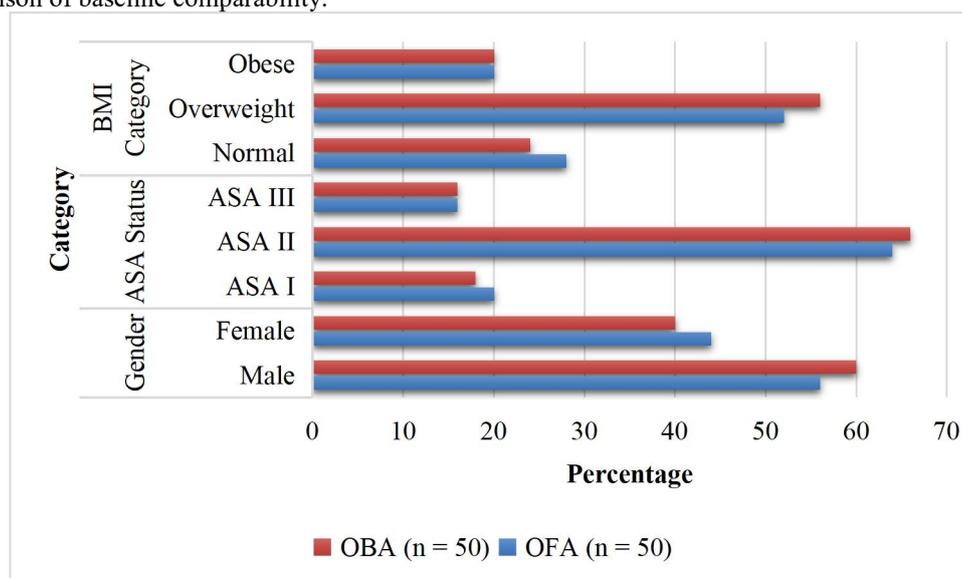


Figure 1. Demographic and Clinical Profile of OFA and OBA Groups

Figure 1 indicates that there was a similarity in the distribution of the gender, ASA, and the BMI in the OFA and the OBA groups. There was no clinically significant imbalance in the baseline characteristics and this justifies the internal validity of the subsequent outcome comparisons. The fact that the distribution of the two cohorts is similar shows that the variation in postoperative opioid use and postoperative recovery results cannot be caused by the difference in the demographic baseline.

Postoperative Opioid Consumption

Table 2 indicated that the consumption of opioids at the first 24 hours following surgery was meaningfully reduced in patients receiving anesthesia without opioids. The difference in 24-hour Morphine Milligram Equivalent (MME) between groups was very significant ($p < 0.001$), and this indicated a strong opioid-sparing effect related to OFA.

Table 2. Postoperative Opioid Consumption

Outcome	OFA (Mean ± SD)	OBA (Mean ± SD)	p-value
24-hour MME (mg)	9.87 ± 4.96	23.71 ± 8.77	<0.001

Figure 2 demonstrates the difference between the overall opioid consumption within the first 24 hours in the OFA and OBA groups. The graphical illustration gives a graphical description of the difference in the cumulative Morphine Milligram Equivalent (MME) used in the two anaesthetic methods.

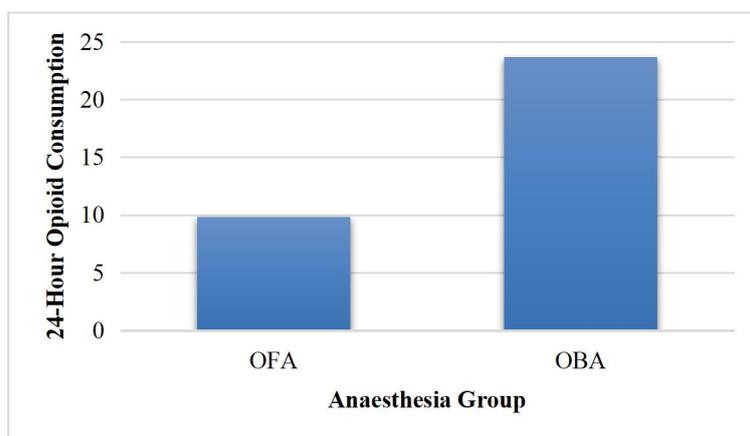


Figure 2. Comparison of 24-Hour Postoperative Opioid Consumption (MME) Among OFA and OBA Groups

Figure 2 presents that patients who were put on the OFA, as they indicated significantly lower 24-hour opioid intake than patients who were put on OBA. The significant difference in groups is a visual support of statistically significant decrease in the opioid requirement in the OFA cohort. This observation helps to justify the opioid-sparing consequence of opioid-free anaesthesia in the framework of the ERAS guideline and suggests its possible use in enhancing postoperative outcomes.

Postoperative Pain Scores

The results of Table 3 indicate that patients who received OFA scored much lower in postoperative pain than those who did not at all time points ($p < 0.001$). These results show that OFA group had better analgesia during the early postoperative period.

Table 3. Postoperative Pain Scores

Time Point	OFA (Mean ± SD)	OBA (Mean ± SD)	p-value
6 hours	3.02 ± 0.96	4.58 ± 1.20	<0.001
12 hours	2.88 ± 0.91	4.05 ± 1.18	<0.001
24 hours	2.55 ± 0.83	3.76 ± 1.09	<0.001

Figure 3 shows postoperative pain intensity in 6, 12 and 24 hours based on the VAS. The graphic representation illustrates how the pain scores changed over time in both the Opioid-Free Anaesthesia and Opioid-Based Anaesthesia groups, which enables a visual comparison of the pain scores in the early postoperative period.

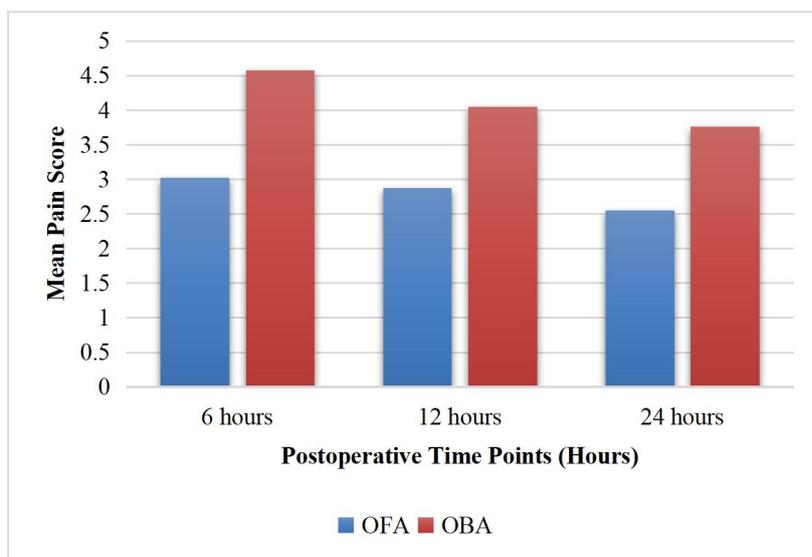


Figure 3. Postoperative VAS Pain Scores at 6, 12, and 24 Hours (OFA vs OBA)

According to the results presented in Figure 3, at every time point of assessment, postoperative pain compared to the OBA group, the OFA group's pain scores were noticeably lower. Over the first 24 hours, both groups' pain levels gradually decreased, but the group with OFA had lower mean VAS scores during the whole time. These results endorse the excellent early analgesic image linked with opioid free anaesthesia in the ERAS protocol.

Comparison of Recovery Parameters

The recovery outcomes were highly biased towards OFA group as shown in Table 5. The duration of the hospital stay and initial ambulation were significantly lower in opioid free anaesthesia patients ($p < 0.001$) which indicates that there is an improved recovery in the postoperative period in the ERAS pathway.

Table 4. Recovery Outcomes

Variable	OFA (Mean ± SD)	OBA (Mean ± SD)	p-value
Time to ambulation (hrs)	8.07 ± 2.03	14.87 ± 3.01	<0.001
Length of stay (days)	2.24 ± 0.71	3.56 ± 0.86	<0.001

Association Between Postoperative Opioid Consumption and Recovery Outcomes

The Pearson correlation analysis showed that there is a substantial positive correlation between 24-hour opioid consumption and length of hospital stay ($r = 0.361$, $p = 0.001$), and between opioid consumption and the early postoperative pain scores ($r = 0.268$, $p = 0.007$). These results suggest that delayed recovery was related to increased opioid use.

Independent Predictors of Postoperative Opioid Consumption

Table 5, which revealed multiple linear regression analysis, found anaesthesia type as the only important independent predictor of postoperative opioid consumption ($p < 0.001$). The general model was statistically significant and it accounted 43.3% of the variation in opioid use ($R^2 = 0.43$). The reasons which were not significant predictors were age, BMI, and length of surgery.

Table 5. Multiple Linear Regression Predicting 24-hour MME

Predictor	β Coefficient	Standard Error	p-value
Anaesthesia type	11.29	1.39	<0.001
Age	-0.01	0.06	0.84
BMI	-0.07	0.24	0.76
Surgery duration	0.02	0.03	0.42

DISCUSSION

As part of an established ERAS, the study evaluated the effectiveness of opioid-free anesthesia (OFA) and showed that postoperative opioid use is reduced significantly, pain management is easier, more people walk sooner, and hospital stay is lessened, when compared to opioid-based anaesthesia (OBA). These results suggest that the removal of intraoperative opioids did not interfere with analgesia, and instead, this treatment was linked to better early recovery. This significant decrease in 24-hours Morphine Milligram Equivalents (MME) indicates that intraoperative opioid avoidance could reduce the postoperative opioid needs, which could reduce the likelihood of adverse effects related to opioids. Additionally, the fact that there is a positive association among the opioid consumption and the delayed recovery parameters supports the idea that opioid increasing exposure can be a contributing factor to increased hospitalization duration and delayed mobilization. The regression model that stated that the anaesthetic technique was the only important predictor of postoperative opioid use shows that the intraoperative analgesic strategy is the main factor determining the postoperative pathways of recovery.

This is in line with other studies that have assessed the use of OFA in the context of ERAS pathways. Soffin et al. (2019) [20] who conducted a retrospective matched cohort study in minimally invasive lumbar spine surgery reported that opioid-free anaesthesia has no effect on perioperative opioid exposure and does not worsen pain control, which supports the opioid-sparing effect of the current study. On the same note, Song et al. (2025) [21] showed a better quality of recovery and reduced postoperative opioid requirements in laparoscopic sleeve gastrectomy surgery with OFA than with conventional opioid-based methods. The decrease in the number of hospital days, as well as the increased rate of early movement noted in our study, is consistent with the overall change in the direction of non-narcotic ERAS models outlined by Wong et al. (2024) [22], who noted that multimodal approaches designed in a structured way can effectively boost the recovery and decrease the use of opioids. These findings are also supported by professional consensus statements. The collective position by Wu et al. (2019) [23] supported the decrease of perioperative opioid usage in opioid-naïve respondents, with multimodal analgesia playing a central role in the philosophy of better recovery. Our findings demonstrate empirical institutional evidence to this recommendation. Moreover, Xu et al. (2025) [24] emphasized the increased involvement of OFA in the gastrointestinal surgery in the context of ERAS, and reported that institutional validation is necessary, which is directly discussed by the given retrospective study. Meta-analytic data of Zhang et al. (2025) [25] indicated that opioid-sparing analgesia is an effective approach to decreasing the use of opioids following surgery and could lead to better recovery outcomes, which are comparable in terms of the magnitude of reduction in opioids and functional recovery in the cohort of our study. The present study in totality can be seen to contribute to existing literature by offering more real-world data about the fact that OFA, when included in an ERAS pathway, can help produce significant decreases in opioid exposure and improve postoperative recovery outcomes.

This study has significant implications on perioperative practice. To begin with, the fact that the opioids consumption has dropped dramatically may indicate that OFA can be included in the opioid stewardship programs focused on reducing the impact of the prolonged opioid exposure. Since the behavior of prescribing opioids postoperatively can be viewed as a pathway to chronic opioid use, an intervention approach that minimizes opioid exposure during the initial stage can have a more widespread effect on the population. Second, there is better early mobilization and the reduction in the duration of hospital stay that translates into the possible economic benefits by less bed occupancy and more patient throughput. Third, the lack of compromised analgesia questions the conventional belief that opioids are essential to a successful fight of perioperative pain. These results justify the expansion of the use of multimodal, opioid-sparing approaches in ERAS programs and in those institutions where the optimization of recovery rates is the goal to achieve, but the number of complications should not be increased.

This study has a few limitations even though it is strong. Being a single center retrospective cohort study, it is prone to selection bias and documentation accuracy limitations. Whereas the baseline characteristics were similar, there might have been unmeasured confounding factors that could have contributed to the results. The comparatively small sample size can be a limiting factor in the generalizability to more heterogeneous population of surgery or more risky patients. Also, the results were mainly analyzed on short-term outcomes in the first 24 hours; no analysis determined on long-standing opioid pain outcomes and sustained opioid usage rates. ERAS components adherence variability although standardized at the institutional level may also result in practice-related subtle variations that were not reflected in retrospective data extraction.

Prospective multicenter randomized controlled trials that would support these results in diverse surgical populations and healthcare environments should be conducted in the future. Prospective studies assessing ongoing opioid use, patient-self-reports, and economic efficacy analyses would enlarge the effect of OFA in a wider sphere of ERAS pathways. OFA protocols and pharmacologic combinations can also be standardized which could help to decrease heterogeneity which can be observed in current studies. Furthermore, the use of factors unique to patients that predict the best response to an opioid-free approach could be used to guide individualized perioperative analgesic planning.

CONCLUSION

This retrospective cohort study shows that opioid-free anaesthesia (OFA), when applied as part of an organised ERAS bundle, is linked to a large-scale decrease of postoperative opioid use and has meaningful changes in early recovery. Patients undergoing OFA counted considerably reduced 24-hour doses of opioids in comparison with the opioid-based anaesthesia (OBA), which validates the existence of a robust opioid-sparing effect. Notably, this opioid exposure did not affect the level of analgesia, but, on the contrary, the results of postoperative pain evaluation at the 6, 12, and the OFA group had fewer 24 hours. Besides the better pain management ability, OFA was also linked to an earlier ambulation process and a reduced hospital stay, which implies better functional recovery. Correlation analysis also showed that increased opioid use was also associated with prolonged recovery parameters, supporting the clinical significance of the minimization of perioperative opioid exposure. Analysis of multiple regression revealed that the first independent predictor of postoperative opioid requirement was the anaesthetic technique highlighting the key role that intraoperative analgesic strategy encompasses in determining the postoperative outcome. All these results suggest that opioid-free anaesthesia should be incorporated into the ERAS pathways as a harmless and efficient measure to minimise the use of opioids and improve the postoperative outcome. Structured multimodal, opioid-sparing methods adopted by the institution can also help to improve patient outcomes and enhance opioid stewardship during perioperative care.

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