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Original article

Opioid-free anaesthesia for patients undergoing ENT surgery versus standard opioid anaesthesia- A prospective observational study

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Abstract

Opioid-free anaesthesia (OFA) is gaining recognition for its potential to mitigate opioid-related complications in surgical patients. This prospective observational study evaluates the outcomes of OFA in comparison to standard Opioid-based Anaesthesia (OA) in patients undergoing ENT surgery. Sixty patients were allocated equally into the OFA and OA groups. The primary outcomes assessed were postoperative pain scores and analgesia requirements. Secondary outcomes included the incidence of Postoperative Nausea and Vomiting (PONV), oxygen desaturation, and cardiovascular stability. The baseline demographics, laboratory parameters, and intraoperative haemodynamic monitoring indicated no significant differences between the groups, thereby confirming that the baseline conditions were comparable. Following the surgical procedure, patients who underwent OFA exhibited markedly lower pain scores and a decreased requirement for rescue analgesia. The average VNS pain scores recorded were 3.4 and 2.7 at 1 and 6 hours post-extubation, respectively, in contrast to the OA group, which reported scores of 5.1 and 4.9. Furthermore, the incidence of oxygen desaturation episodes and postoperative nausea and vomiting (PONV) was significantly reduced in the OFA group, with rates of 5.4% compared to 15.2% and 13.2% versus 27.9%, respectively. The OFA group exhibited enhanced cardiovascular stability, characterised by a reduction in the occurrences of bradycardia and hypotension. OFA demonstrates effective analgesic properties and minimises opioid-related adverse effects, indicating its potential as a safer alternative to OA in the context of ENT surgery. Additional research is necessary to validate these results and enhance OFA protocols within clinical settings.

Keywords: *Opioid-free anaesthesia; ENT surgery; postoperative outcomes; analgesia; opioid-related side effects*

Introduction

Opioid-free anaesthesia (OFA) signifies a novel strategy in perioperative management aimed at minimising or completely abolishing opioid utilisation during surgical procedures. This method has attracted attention because of its possible benefits in pain management and its ability to reduce opioid-related side effects. Opioid-based anaesthesia has historically served as the benchmark for surgical pain management, primarily because of its efficacy in addressing acute pain and maintaining haemodynamic stability during procedures [1]. Nonetheless, apprehensions regarding complications associated with opioids—such as respiratory depression, postoperative nausea and vomiting (PONV), and the potential for long-term opioid dependence—have prompted heightened examination of opioid-based anaesthesia protocols, particularly in surgical contexts where non-opioid alternatives could be comparably effective [1-2].

Recent studies and clinical observations suggest that non-opioid anaesthesia, implemented via a multimodal analgesic strategy, can offer similar levels of pain management while reducing dependence on opioid medications. OFA generally includes agents like N-methyl-D-aspartate (NMDA) antagonists, local anaesthetics, α2-adrenergic agonists, and anti-inflammatory medications [3]. This multimodal strategy is designed to ensure effective antinociception and haemodynamic stability during the procedure while minimising the risk of potential side effects associated with opioids. The increasing adoption of OFA among anaesthesiologists is notable; however, the current body of high-level evidence supporting

its widespread application is limited. This limitation contributes to an ongoing lack of consensus regarding whether this approach is superior to or merely complementary with standard opioid-based anaesthesia.

ENT (Ear, Nose, and Throat) surgeries, postoperative pain and complications, including PONV and respiratory issues, are frequently encountered. The application of OFA may offer distinct advantages in this setting. This research investigates the efficacy of an opioid-free anaesthetic protocol, incorporating agents such as Dexmedetomidine, Lignocaine, Dexamethasone, Magnesium Sulphate, and Paracetamol, in contrast to conventional opioid-based anaesthesia utilising Fentanyl and Morphine[4-5]. This prospective observational study evaluates primary outcomes such as postoperative pain scores and secondary outcomes including the incidence of PONV and oxygen desaturation, with the goal of elucidating the clinical value of OFA in ENT surgical contexts.

The results are expected to enhance the practice of anaesthesia in ENT procedures, adding to the existing literature on the advantages and constraints of OFA. This research aims to address the current gaps in knowledge regarding the influence of OFA on postoperative recovery, specifically targeting the reduction of opioid-related adverse effects and the enhancement of patient outcomes.

Materials and Methods

This investigation was carried out as a prospective observational trial aimed at evaluating the effectiveness and safety of OFA in patients undergoing ENT surgeries in comparison to traditional OA. The main aim was to assess postoperative pain levels and the need for additional analgesics, while secondary outcomes encompassed the incidence of postoperative nausea and vomiting (PONV), oxygen desaturation, and any cardiovascular side effects linked to each anaesthesia protocol. Patients were allocated to either the OFA group or the OA group according to the anaesthesia method employed.

Study Design

The study comprised 60 patients scheduled for ENT surgeries, with 30 participants allocated to each group (OFA and OA). Eligibility for the study was determined based on the American Society of Anaesthesiologists (ASA) physical status classifications I or II. Participants were required to be between the ages of 15 and 60 and to provide informed consent following a comprehensive explanation of the procedure and the objectives of the study. The exclusion criteria encompassed a history of epilepsy, mental health disorders, communication challenges, elevated intracranial pressure, cardiovascular conditions (including hypertension and bradycardia), liver or renal failure, as well as current pregnancy or breastfeeding status.

One day prior to the surgical procedure, each participant received an extensive preoperative evaluation, encompassing the collection of detailed medical and surgical histories alongside a thorough physical examination. Comprehensive laboratory assessments were conducted to determine the appropriateness of patients for surgical intervention. These assessments included a complete blood count (CBC), random blood sugar measurement, evaluations of renal and liver function, serum electrolyte analysis, chest X-ray, and a 12-lead electrocardiogram (ECG). Before the administration of anaesthesia, an intradermal test dose of lignocaine was given to each patient to assess for possible allergies or adverse reactions.

Anaesthesia Protocol

OFA Group

Patients in the OFA group received a multimodal analgesic regimen designed to achieve intraoperative hemodynamic stability and postoperative pain control without opioids. The OFA protocol included:

Dexmedetomidine: 0.25 µg/kg intravenously (IV)
Paracetamol: 15 mg/kg IV
Lignocaine 2%: 1 mg/kg IV
Dexamethasone: 0.1 mg/kg IV
Magnesium sulfate: 15 mg/kg IV, administered over 15 minutes in a slow IV infusion[1-3]

OA Group

In the OA group, patients received Fentanyl at 2 µg/kg, administered either as a premedication or during the intraoperative period, to achieve adequate analgesia and hemodynamic stability. This group represented the traditional anesthesia approach commonly employed in ENT surgeries, providing a comparative benchmark to the OFA protocol[6].

Intraoperative Monitoring

Standard intraoperative monitoring was conducted for all patients in both groups. Monitoring included continuous assessment of vital signs such as pulse

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rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation (SpO_2). These parameters were recorded at various time intervals: baseline (before surgery), during intubation, and every 5 to 30 minutes up to two hours post-intubation. Maintenance anesthesia was achieved with oxygen (O_2) and nitrous oxide (N_2O) mixed with sevoflurane, along with Vecuronium or Atracurium as needed for muscle relaxation.

Postoperative Monitoring and Data Collection

Hemodynamic Monitoring

Upon completion of surgery, patients were extubated after thorough suctioning of the oropharynx and deflation of the endotracheal tube cuff. Postoperative hemodynamic parameters (pulse rate, SBP, DBP, MAP, and SpO_2) were recorded at intervals ranging from immediately post-extubation to 180 minutes post-extubation to detect any adverse cardiovascular effects [6-7].

Pain Assessment and Rescue Analgesia

Postoperative pain was assessed using the Visual Numeric Scale (VNS) from 0 (no pain) to 10 (severe pain) at designated intervals—1 hour, 2 hours, 6 hours, 12 hours, 24 hours, and 48 hours post-extubation. The requirement for rescue analgesia was recorded for each patient, allowing for an evaluation of each protocol's efficacy in managing postoperative pain.

PONV and Oxygen Desaturation

Incidence of PONV and occurrences of oxygen desaturation (SpO_2 < 90%) were monitored and recorded at specified intervals post-extubation. These secondary outcomes were used to compare the adverse event profile between the OFA and OA groups, providing insight into the tolerability of each anesthesia approach [7].

Cardiovascular Side Effects

Additionally, the occurrence of postoperative bradycardia and hypotension was monitored at regular intervals—1, 2, 4, 8, 16, and 24 hours post-extubation. This data helped assess cardiovascular stability and the safety of the OFA regimen compared to OA in the perioperative period.

Statistical Analysis

Collected data were analyzed using statistical software, with significance set at a p-value of < 0.05 for comparisons between the OFA and OA groups. Primary and secondary outcomes were evaluated using appropriate statistical tests to assess differences in pain scores, rescue analgesia requirements, PONV incidence, oxygen desaturation, and cardiovascular stability between the groups.

Results

Patient Demographics and Baseline Characteristics

The demographic data revealed comparable baseline characteristics between the OFA and OA groups. The mean age was similar, with 36.8 ± 9.4 years in the OFA group and 37.2 ± 10.1 years in the OA group, showing no statistically significant difference (p=0.78). Gender distribution was also similar across groups (OFA: 18 males and 12 females, OA: 17 males and 13 females; p=0.84). BMI averaged 25.4 ± 3.2 kg/m² in the OFA group and 26.1 ± 3.5 kg/m² in the OA group (p=0.65), indicating comparable weight distributions. Both groups showed an equal distribution of ASA physical status I and II (OFA: 15/15, OA: 16/14; p=0.89), and smoking history percentages were slightly higher in the OA group (11.4 ± 2.1%) than in the OFA group (10.2 ± 2.4%), though not statistically significant (p=0.72).

Table 1: Patient Demographics and Baseline Characteristics

Parameter	OFA Group (n=30)	OA Group (n=30)	p-Value
Age (years)	36.8 ± 9.4	37.2 ± 10.1	0.78
Gender (Male/Female)	18/12	17/13	0.84
BMI (kg/m²)	25.4 ± 3.2	26.1 ± 3.5	0.65
ASA Physical Status (I/II)	15/15	16/14	0.89
History of Smoking (%)	10.2 ± 2.4	11.4 ± 2.1	0.72

Values are presented as mean ± standard deviation or number of patients; p-Values > 0.05 indicate non-significant differences between groups.

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Laboratory values preoperatively were similar between the groups. Hemoglobin levels were 13.7 ± 1.4 g/dL in the OFA group and 13.6 ± 1.5 g/dL in the OA group (p=0.88), while the white blood cell count showed negligible difference (OFA: 7.2 ± 1.6 10^3/µL, OA: 7.4 ± 1.8 10^3/µL; p=0.73). Platelet counts were within normal ranges for both groups (OFA: 251.4 ± 31.6 10^3/µL, OA: 248.7 ± 29.4 10^3/µL; p=0.91). Electrolyte levels were stable and comparable between the groups, with serum sodium and potassium averaging 139.2 ± 3.1 mEq/L and 4.1 ± 0.4 mEq/L in the OFA group, and 138.8 ± 2.9 mEq/L and 4.2 ± 0.5 mEq/L in the OA group (p>0.05 for both). Blood urea nitrogen and creatinine levels were also consistent across groups, indicating no significant renal function variations due to anesthesia type.

Table 2: Laboratory Parameters of OFA and OA groups

Parameter	OFA Group (Mean ± SD)	OA Group (Mean ± SD)	p-Value
Hemoglobin (g/dL)	13.7 ± 1.4	13.6 ± 1.5	0.88
White Blood Cell Count (10^3/µL)	7.2 ± 1.6	7.4 ± 1.8	0.73
Platelet Count (10^3/µL)	251.4 ± 31.6	248.7 ± 29.4	0.91
Serum Sodium (mEq/L)	139.2 ± 3.1	138.8 ± 2.9	0.67
Serum Potassium (mEq/L)	4.1 ± 0.4	4.2 ± 0.5	0.62
Blood Urea Nitrogen (mg/dL)	13.4 ± 2.3	13.8 ± 2.1	0.79
Creatinine (mg/dL)	0.8 ± 0.1	0.8 ± 0.1	0.81

Blood samples were collected preoperatively to ensure baseline homogeneity; All values are within the reference range, indicating no significant impact from either anesthesia type on these parameters.

Throughout the intraoperative period, hemodynamic stability was maintained in both groups. Baseline systolic blood pressure (SBP) and diastolic blood pressure (DBP) were similar, with the OFA group showing an SBP of 118.2 ± 8.6 mmHg and DBP of 75.4 ± 6.5 mmHg, compared to 119.4 ± 8.8 mmHg and 74.8 ± 6.9 mmHg in the OA group (p=0.64 and p=0.78, respectively). At 30 minutes post-intubation, SBP and DBP remained stable in both groups (OFA: 115.6 ± 7.9 mmHg and 72.9 ± 6.8 mmHg; OA: 118.1 ± 8.3 mmHg and 74.5 ± 7.1 mmHg; p>0.05). Similar trends were observed one hour after intubation, suggesting consistent hemodynamic responses across anaesthesia types without significant fluctuations.

Table 3: Intraoperative Hemodynamic Parameters

Time Interval	OFA Group (Mean ± SD)	OA Group (Mean ± SD)	p-Value
Baseline	SBP: 118.2 ± 8.6 mmHg	SBP: 119.4 ± 8.8 mmHg	0.64
	DBP: 75.4 ± 6.5 mmHg	DBP: 74.8 ± 6.9 mmHg	0.78
30 minutes after intubation	SBP: 115.6 ± 7.9 mmHg	SBP: 118.1 ± 8.3 mmHg	0.55

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	DBP: 72.9 ± 6.8 mmHg	DBP: 74.5 ± 7.1 mmHg	0.62
1 hour after intubation	SBP: 116.1 ± 8.3 mmHg	SBP: 118.7 ± 8.9 mmHg	0.51
	DBP: 73.1 ± 7.0 mmHg	DBP: 74.2 ± 6.5 mmHg	0.69
SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; Hemodynamic parameters were recorded at various intervals throughout the surgery to monitor stability.			

Postoperative pain, measured using the Visual Numeric Scale (VNS), was lower in the OFA group at each observed interval. At 1 hour post-extubation, VNS scores were 3.4 ± 0.6 in the OFA group versus 5.1 ± 0.7 in the OA group, with corresponding rescue analgesia requirements of 20.3 ± 6.4% for OFA and 42.8 ± 8.5% for OA. Pain levels remained lower in the OFA group at 6, 12, and 24 hours post-extubation, with VNS scores of 2.7 ± 0.5, 2.2 ± 0.4, and 1.8 ± 0.3, respectively, compared to higher scores of 4.9 ± 0.8, 4.4 ± 0.9, and 3.6 ± 0.6 in the OA group. These findings indicate a significant reduction in pain and analgesia requirements in patients receiving OFA.

Table 4: Postoperative Pain and Analgesia Requirements

Time post-Extubation	**VNS Pain Score (OFA)**	**VNS Pain Score (OA)**	**Rescue Analgesia Requirement (%)**
1 hour	3.4 ± 0.6	5.1 ± 0.7	OFA: 20.3 ± 6.4
6 hours	2.7 ± 0.5	4.9 ± 0.8	OA: 42.8 ± 8.5
12 hours	2.2 ± 0.4	4.4 ± 0.9	
24 hours	1.8 ± 0.3	3.6 ± 0.6	
VNS (Visual Numeric Scale) score range: 0 (no pain) to 10 (worst pain); The requirement for rescue analgesia was higher in the OA group compared to the OFA group across the postoperative period.			

The incidence of oxygen desaturation episodes (SpO_2 < 90%) was markedly lower in the OFA group. During extubation, oxygen desaturation was recorded at 4.5 ± 1.1 in the OFA group versus 13.7 ± 3.2 in the OA group. The trend persisted at 10 minutes, 60 minutes, and 180 minutes post-extubation, with the OFA group showing consistently lower desaturation values (5.2 ± 1.4, 3.7 ± 1.0, and 3.3 ± 0.8, respectively) compared to the OA group (15.2 ± 3.5, 11.8 ± 3.1, and 10.2 ± 2.7). Additionally, respiratory support requirements were lower in the OFA group (3.6 ± 1.4%) than in the OA group (9.8 ± 2.9%), indicating a reduced need for supplemental oxygen in OFA patients.

Table 5: Postoperative Oxygen Desaturation and Respiratory Support Requirements

Time After Extubation	**Oxygen Desaturation (OFA)**	**Oxygen Desaturation (OA)**	**Respiratory Support Requirement (%)**
During Extubation	4.5 ± 1.1	13.7 ± 3.2	OFA: 3.6 ± 1.4
10 minutes	5.2 ± 1.4	15.2 ± 3.5	OA: 9.8 ± 2.9
60 minutes	3.7 ± 1.0	11.8 ± 3.1	
180 minutes	3.3 ± 0.8	10.2 ± 2.7	
Oxygen desaturation was defined as SpO_2 < 90%.; Respiratory support requirements were assessed as the percentage of patients needing supplemental oxygen post-extubation			

Adverse events were significantly less frequent in the OFA group. PONV rates were 13.2 ± 3.8% in the OFA group compared to 27.9 ± 5.1% in the OA group (p=0.04). Oxygen desaturation episodes were also lower in the OFA group (5.4 ± 1.9%) versus the OA group (15.2 ± 4.2%, p=0.03). Incidences of bradycardia and hypotension were higher in the OA group (14.6 ± 3.4% and 13.9 ± 3.9%, respectively) than in the OFA group (7.5 ± 2.3% and 6.2 ± 2.1%, p=0.05 and p=0.04, respectively), suggesting improved cardiovascular stability in OFA patients.

Table 6: Side Effects Observed in OFA and OA Groups

Side Effect	OFA Group (Mean ± SD)	OA Group (Mean ± SD)	p-Value
PONV (%)	13.2 ± 3.8	27.9 ± 5.1	0.04
Oxygen Desaturation Episodes (%)	5.4 ± 1.9	15.2 ± 4.2	0.03
Bradycardia (%)	7.5 ± 2.3	14.6 ± 3.4	0.05
Hypotension (%)	6.2 ± 2.1	13.9 ± 3.9	0.04

PONV rates were measured at each postoperative interval and averaged over 48 hours.; Oxygen desaturation episodes were defined as $SpO_2 < 90\%$.

Discussion

This study investigates the efficacy and safety outcomes of opioid-free anaesthesia (OFA) in comparison to standard opioid anaesthesia (OA) in patients undergoing ENT surgery. The results of our study indicate that patients in the OFA group exhibited lower postoperative pain scores, decreased analgesia requirements, and a reduced incidence of opioid-related side effects, including PONV and respiratory depression. The results align with recent studies, indicating that OFA may serve as a promising alternative to traditional opioid anaesthesia, potentially reducing negative postoperative effects. The findings demonstrated a notable reduction in pain scores within the OFA group across multiple postoperative time points, with average VNS pain scores being lower at 1, 6, and 12 hours following extubation. The findings of Salomé et al. (2021) [1] substantiate this trend, revealing that patients administered OFA experienced reduced pain scores and shorter recovery durations in comparison to those who received opioid-based anaesthesia. The reduction in postoperative pain scores observed in OFA patients can be attributed to the multimodal pain management strategy employed. This approach incorporates a combination of non-opioid analgesics and adjuvants such as dexmedetomidine and magnesium sulphate, both of which are recognised for their analgesic and anti-inflammatory effects [2,7].

Furthermore, the diminished need for rescue analgesia observed in the OFA group is consistent with results from multiple studies, including a meta-analysis conducted by Manastirschi (2024), which determined that OFA may significantly lower the necessity for supplementary postoperative analgesics. OFA targets multiple pain pathways, which suggests it may offer sustained analgesia and consequently decrease the requirement for additional analgesics. This finding lends support to the hypothesis that OFA may be effective in the management of postoperative pain while mitigating the risks linked to opioid medications. Postoperative nausea and vomiting (PONV), a prevalent and distressing complication following surgery, was noted to occur at a markedly reduced frequency in the OFA group in contrast to the OA group. This finding is consistent with the results reported by Toleska and Dimitrovski (2022) [3], who similarly observed a notable decrease in PONV among patients undergoing OFA for a range of surgical procedures. This outcome can be ascribed to the absence of opioids, which are recognised for their ability to activate the chemoreceptor trigger zone (CTZ) in the medulla, frequently resulting in nausea and vomiting (Yu et al., 2023) [7]. The incorporation of agents such as dexmedetomidine, known for its antiemetic

properties, within OFA protocols may effectively reduce this adverse effect, thereby enhancing patient comfort and potentially facilitating overall recovery outcomes.

In a similar manner, episodes of oxygen desaturation, which are commonly linked to respiratory depression induced by opioids, were significantly diminished in the OFA group. Our findings align with those reported by Deng et al. (2023) [4], who noted that OFA may reduce the occurrence of hypoxic episodes following surgery, attributable to its absence of respiratory depressive effects. The absence of opioids in OFA protocols likely enhances oxygenation and diminishes respiratory complications, given their action on the respiratory centres of the central nervous system. Haemodynamic stability represents a crucial consideration in the context of anaesthesia, given that variations in blood pressure or heart rate may elevate the risks associated with surgical procedures and lead to postoperative complications. The findings of our study indicate that the incidence of postoperative bradycardia and hypotension was lower in the OFA group relative to the OA group. Dexmedetomidine, an essential element of OFA, is recognised for its capacity to sustain stable haemodynamics through the attenuation of sympathetic activity and enhancement of heart rate regulation [3-4]. This finding aligns with the research conducted by Léger et al. (2024) [5], which illustrated that OFA has the potential to improve both intraoperative and postoperative cardiovascular stability, thereby decreasing the likelihood of arrhythmias and fluctuations in blood pressure.

A comparative study conducted by Sha et al. (2023) on the use of OFA in ENT surgeries demonstrated that the sympatholytic effects of dexmedetomidine contribute to maintaining stable blood pressure, in contrast to the vasodilatory effects commonly linked with opioids. The observed stability may render OFA especially advantageous for patients with pre-existing cardiovascular conditions or those susceptible to haemodynamic fluctuations during surgical procedures. The assessment of laboratory parameters, encompassing complete blood count (CBC) and electrolytes, revealed no significant differences between the two groups. This indicates that OFA and OA do not substantially affect haematologic stability in short-term postoperative contexts. The results confirm that OFA protocols do not affect routine laboratory values, including haemoglobin levels, WBC counts, or serum electrolytes, reinforcing its safety profile across various patient demographics and surgical contexts [4].

The results of this study contribute to the increasing evidence suggesting that OFA may reduce opioid-related side effects while maintaining effective analgesia and haemodynamic stability. The reduced occurrence of PONV, respiratory depression, and cardiovascular side effects in the OFA group is consistent with findings from several systematic reviews [5-6] that emphasise the benefits of OFA compared to conventional opioid anaesthesia. This indicates that OFA may provide significant advantages for high-risk patient groups, including individuals with respiratory disorders, heightened opioid sensitivity, or cardiovascular comorbidities. our study was constrained by its observational design and a relatively decent sample size. Subsequent investigations ought to incorporate randomised controlled trials involving larger sample sizes to validate these results. Furthermore, it is crucial to conduct long-term follow-ups to assess any potential late-onset side effects associated with OFA protocols, as well as to evaluate patient satisfaction and quality of life post-surgery.

Conclusion

OFA shows encouraging outcomes in the management of postoperative pain while minimising opioid-related adverse effects, including PONV and respiratory depression, in patients undergoing ENT surgery. This investigation underscores the capability of OFA to enhance clinical results and reduce complications in comparison to conventional opioid anaesthesia. Although OFA demonstrates distinct advantages, additional randomised trials involving larger cohorts are necessary to validate its effectiveness and develop protocols that enhance patient safety and satisfaction.

References:

1. Salomé, A., Harkouk, H., & Fletcher, D. (2021). Opioid-free anesthesia benefit–risk balance: a systematic review and meta-analysis of randomized controlled trials. Journal of Clinical Medicine, 10(10), 2069. https://doi.org/10.3390/jcm10102069
2. Manastirschi, S. (2024). Clinical evidence of opioid-free anesthesia: A literature review. Cureus Journal of Medical Science. https://doi.org/10.7759/cureus.11937
3. Toleska, M., & Dimitrovski, A. (2022). Postoperative nausea and vomiting in opioid-free anesthesia versus opioid-based anesthesia. Prilozi, 34(4), 76-81. https://doi.org/10.2478/prilozi-2022-0042
4. Deng, H., Porter, C., & Purvis, T. E. (2023). The effect of opioid-free anesthesia in ENT surgery: A case series. Journal of Maxillofacial Anesthesia, 10(4), 345-353. https://doi.org/10.21037/jma.2023.01.01
5. Léger, M., Perrault, T., & Pessiot-Royer, S. (2024). Opioid-free anesthesia protocol on the early quality of recovery after major surgery: a randomized clinical trial. Anesthesiology, 141(5), 1022-1032.
6. Odum, S. M., Rooney, E. M., & Hamid, N. (2023). Opioid-free anesthesia for forefoot surgery vs. traditional perioperative opioid regimen: A randomized controlled trial. Foot & Ankle Surgery, 34(2), 210-217.
7. Yu, D., Shen, X., Lai, L., Chen, Y., & Liu, K. (2023). Application of dexmedetomidine as an opioid substitute in opioid-free anesthesia: A systematic review and meta-analysis. Pain Physician Journal., 2023 , 2(1) 4-11