



IMPACT OF MULTIMODAL ANALGESIA PROTOCOL ON CLINICAL OUTCOME IN CRITICALLY ILL PATIENTS IN AN INTENSIVE CARE UNIT: A PROSPECTIVE OBSERVATIONAL STUDY OVER A PERIOD OF 18 MONTHS IN SICU, SMHS HOSPITAL GMC SRINAGAR J and K.

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Abstract

Background: Pain management in critically ill surgical patients is often challenging due to altered physiology, need for mechanical ventilation, and the risks associated with opioid use. Multimodal analgesia protocols have been increasingly recognized as effective strategies to reduce opioid dependence while maintaining adequate pain control. **Aim:** To evaluate the impact of a multimodal analgesia protocol on clinical outcomes in critically ill patients admitted to the Surgical Intensive Care Unit (SICU) of SMHS Hospital, Government Medical College Srinagar. **Methods:** This prospective observational study was conducted over 18 months and included 700 critically ill patients admitted to the SICU. Pain was assessed using Visual Analogue Scale (VAS) or Numerical Rating Scale (NRS) in communicative patients and Behavioral Pain Scale (BPS) in intubated patients. Analgesics were administered according to a protocol that utilized non-opioids, weak opioids, opioids, adjuvants, and regional blocks based on pain severity. Data were analyzed using SPSS version 23, with Mann-Whitney U and Spearman's correlation tests applied where appropriate. **Results:** The mean age of the study population was 49.2±20.97 years, with a male predominance (64%). Most patients belonged to the general surgery department (25.1%), and exploratory laparotomy was the most common procedure (28.3%). Of the total, 42.9% were intubated and 57.1% extubated. The mean duration of mechanical ventilation was 76.6±61.87 hours, while the mean ICU stay was 5.4±4.43 days. Non-opioid analgesics, particularly paracetamol (66.5%), diclofenac (30%), and regional techniques (44%), were widely used. Opioid use was minimized, with morphine required only in 15% of intubated patients. The multimodal protocol was associated with effective pain control, reduced opioid requirements, and acceptable ICU outcomes. **Conclusion:** Implementation of a multimodal analgesia protocol in the SICU setting improved pain control while reducing opioid exposure, supporting its role in optimizing recovery and clinical outcomes in critically ill surgical patients. Wider adoption of such structured protocols may enhance perioperative care and resource utilization in intensive care units.

Keywords: multimodal analgesia, pain management, surgical ICU, opioids, clinical outcomes

Introduction

Pain management is a critical component of medical professionalism. Since the American Pain Society declared “pain: the fifth vital sign” in 1995, clinicians have become increasingly aware of the importance of effective pain control, leading to greater research in this area [1]. Patients admitted to the surgical intensive care unit (SICU) are particularly vulnerable to severe pain as a result of tissue injury due to inflammation, major surgery, trauma, and invasive monitoring procedures. Routine nursing care such as dressing changes and airway suctioning can also contribute to significant discomfort [2–4].

The prevalence of pain among SICU patients has been reported to range between 40% and 77% [5–7]. Failure to perform proper pain assessment often results in inadequate management, which in turn leads to acute and chronic physiological and psychological consequences [5]. Regular pain assessment alone has been shown to improve outcomes, including reduced ventilator days, shorter ICU stays, and improved survival [8,9]. Protocol-based analgesic strategies that incorporate validated and frequent assessments have been associated with significantly improved patient outcomes [10,11].

Despite these benefits, SICU patients remain at high risk of under-treatment of pain. Difficulties in pain recognition and assessment, particularly among intubated patients, contribute to the problem. Payen et al. [17] reported that pain was accurately assessed in fewer than 40% of mechanically ventilated patients. The use of sedatives, analgesics, and disease-related factors often further diminish communication ability [13–16]. Unrelieved pain in this population is associated with numerous complications, including prolonged mechanical ventilation, hypoxemia, thromboembolism, self-extubation, delirium, myocardial ischemia, immunosuppression, and chronic pain syndromes [18].

Opioids remain the mainstay of pharmacological therapy in SICU patients, with recent guidelines recommending intravenous opioids as first-line agents for non-neuropathic pain [18]. Indeed, more than 80% of mechanically ventilated SICU patients are reported to receive opioid therapy [19]. However, both short- and long-term adverse effects of opioids—including tolerance, dependence, immunosuppression, respiratory depression, ventilator-associated pneumonia, delirium, and prolonged ICU stay—are well documented [18].

Multimodal analgesia has therefore emerged as a preferred strategy for pain management, reducing reliance on opioids while improving analgesic efficacy [20]. It involves combining agents with different mechanisms of action—such as opioids, non-opioid analgesics, local anesthetics, ketamine, and $\alpha 2$ -agonists—to achieve additive or synergistic pain relief while minimizing adverse effects [21]. This approach is strongly recommended in critically ill patients, especially those with impaired cognition or communication barriers [22]. Incorporating pain management into daily SICU checklists and involving anesthesiology-based pain services have also been shown to improve outcomes and reduce the burden on ICU teams [23,24].

Despite the availability of evidence-based guidelines, implementation of standardized pain management practices remains inconsistent. A multicenter observational survey found that only 42% of mechanically ventilated SICU patients underwent formal pain assessment, even though 90% were receiving opioids [24–26]. Structured pain management protocols are therefore essential to optimize sedation, reduce unnecessary drug exposure, and improve both short- and long-term outcomes in this vulnerable patient population.

Materials and Methods

Study design and setting

This prospective observational study was conducted in the Postgraduate Department of Anaesthesiology and Critical Care, SICU, SMHS Hospital (an associate hospital of Government Medical College Srinagar). The study period was 18 months. Ethical clearance was obtained from the Institutional Ethical Committee, and informed consent was taken from patients' attendants prior to inclusion.

Study population

Inclusion criteria:

- * Patients aged ≥ 18 years.
- * Patients or attendants providing consent.
- * Patients admitted to the SICU during the study period.

Exclusion criteria:

- * Patients aged < 18 years.
- * Patients or attendants refusing consent.

Pain assessment

Systematic pain assessment was carried out every four hours using validated and standardized scales.

- * Communicative patients: Pain was assessed using the Visual Analogue Scale (VAS) and the Numerical Rating Scale (NRS).
- * VAS: A 0–10 scale, with 0 indicating no pain and 10 the worst imaginable pain.
- * NRS: A simplified numeric scale from 0–10 with similar interpretation.
- * Intubated or non-communicative patients: The Behavioral Pain Scale (BPS) was used, which evaluates pain based on facial expression, upper limb movement, and compliance with ventilation.

BPS components included:

- * Facial expression: relaxed (1) to grimacing (4).
- * Upper limbs: no movement (1) to permanently retracted (4).
- * Compliance with ventilation: tolerating (1) to unable to control (4).

Scores ≤ 5 were considered adequate pain control, whereas scores > 5 indicated inadequate analgesia requiring intervention.

Analgesic protocol

Analgesics were administered based on pain scores:

Pain Score (VAS/NRS)	Interpretation	Action
0	Pain-free	No analgesic required
1–3	Mild pain	Non-opioid analgesics (NSAIDs, paracetamol)
4–6	Moderate pain	Weak opioids (tramadol) $\pm$ non-opioids
≥ 7	Severe pain	Opioids (morphine, fentanyl) + adjuvants

For intubated patients with BPS > 5 , multimodal therapy was employed using opioids (morphine, fentanyl), NSAIDs, paracetamol and regional blocks when appropriate. Analgesics were also administered prophylactically before painful procedures such as dressings, line insertions, or tracheal suctioning.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS Version 23.

- * Univariate analysis: Mann–Whitney U test for pain assessments.
- * Correlation analysis: Spearman's correlation coefficient for continuous measures.

Results

A total of 700 critically ill patients admitted to the SICU were included in the study. The demographic and clinical characteristics, type of surgery, reasons for ICU admission, analgesic use, and clinical outcomes are summarized below [Table 1].

The mean age of patients was 49.2 ± 20.97 years, ranging from 18 to over 70 years. The largest group of patients (30.0%) belonged to the 41–50 year age group, followed by 21.1% in the 51–60 year group. Males constituted 64% of the study population, while females accounted for 36%.

Table 1: Demographic profile of patients

Variable	Number	Percentage
Age 18–20 years	37	5.28
21–30 years	69	9.85
31–40 years	98	14.00
41–50 years	210	30.00
51–60 years	148	21.14
61–70 years	78	11.14
>70 years	59	8.42
Mean $\pm$ SD	49.2 ± 20.97	
Gender		
Male	448	64.00
Female	252	36.00

The most common surgical procedure was exploratory laparotomy (28.28%), followed by nephrectomy (18.71%), gastrectomy (13.42%), and thyroidectomy (9.28%). Less frequent surgeries included hepatectomy (1.28%) and Whipple's procedure (4.28%) [Table 2].

Table 2: Distribution of patients according to type of surgery

Type of Surgery	Number	Percentage
Exploratory laparotomy	198	28.28
Nephrectomy	131	18.71
Gastrectomy	94	13.42
Cholecystectomy	35	5.00
Hemicolectomy	49	7.00
Thoracotomy	61	8.71
Thyroidectomy	65	9.28
Whipple's procedure	30	4.28
Hepatectomy	9	1.28
Others	28	4.00

The primary reasons for SICU admission were metabolic acidosis with hemodynamic instability (27.85%) and isolated hemodynamic instability (18.28%). Post-extubation desaturation with respiratory acidosis was also a frequent indication (10.14%) [Table 3].

Table 3: Reasons for ICU admission

Reason for ICU Admission	Number	Percentage
Hemodynamic instability	128	18.28
Metabolic acidosis + hemodynamic instability	195	27.85
Multiple transfusions + hemodynamic instability	49	7.00
Preoperative low GCS	48	6.85
Type of surgery	38	5.42

Surgery + hemodynamic instability	76	10.85
Low GCS + hemodynamic instability	19	2.71
Respiratory acidosis	25	3.57
Post-extubation desaturation + respiratory acidosis	71	10.14
Preoperative low SpO ₂	51	7.28

The multimodal analgesia protocol included the use of opioids, non-opioids, adjuvants, and regional techniques. Paracetamol was the most frequently administered drug, given in 69% of intubated and 64% of extubated patients. Fentanyl was required in 39% of intubated and 34% of extubated patients, whereas morphine was exclusively used in intubated patients (15%). Regional analgesia with ropivacaine was provided to 41% of intubated and 47% of extubated patients.

Table 4: Analgesic use among study patients

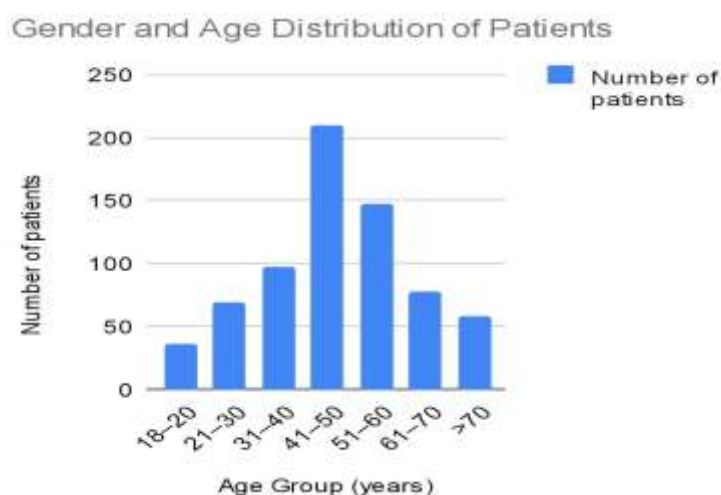
Analgesic	Intubated (n=300)	%	Extubated (n=400)	%
Paracetamol	207	69	256	64
Tramadol	75	25	116	29
Diclofenac	84	28	132	33
Ketorolac	15	5	28	7
Fentanyl	117	39	136	34
Morphine	45	15	0	0
Ropivacaine (blocks/epidural)	123	41	188	47

The mean duration of SICU stay was 5.4 ± 4.43 days. Most patients (55.85%) stayed between 3–5 days, while 31% were discharged within 3 days. Only 4.71% required ICU care for more than 7 days [Table 5].

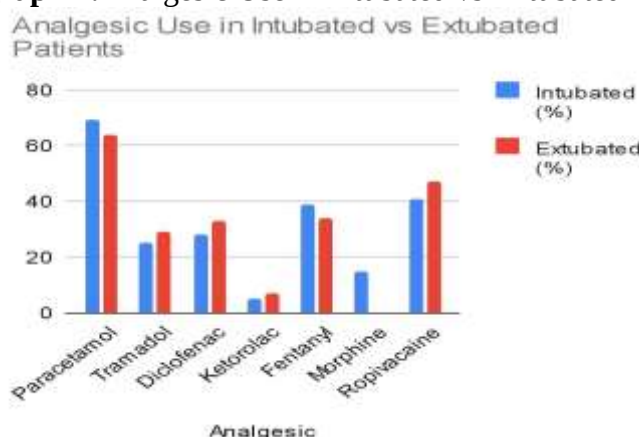
Table 5: Clinical outcomes: ICU stay duration

SICU Stay (Days)	Number	Percentage
< 3 days	217	31.00
3–5 days	391	55.85
5–7 days	59	8.42
≥ 7 days	33	4.71
Mean $\pm$ SD = 5.4 ± 4.43		

Bar graph 1: Gender and Age Distribution of Patients.



Bar graph 2:Analgesic Use in Intubated vs Extubated Patients.



Discussion

In this study of 700 SICU patients, the multimodal analgesia protocol showed meaningful patterns in analgesic use and clinical outcomes. Several findings merit comparison with prior research to understand implications, limitations, and future directions.

The demographic data showed a broad range of ages, mean 49.2 ± 20.97 years, with most patients between 41-60 years. This is similar to many ICU populations, though younger average ages are occasionally reported in trauma units. The male predominance (64%) aligns with many critical care cohorts, possibly reflecting higher rates of surgical admissions or comorbid trauma among males.

Type of surgery data indicated that exploratory laparotomy (28.28%), nephrectomy, and gastrectomy were among the most frequent procedures. Patients undergoing major abdominal surgeries are often at higher risk of postoperative pain and complications related to analgesic management, which supports the need for multimodal protocols in such settings.

Regarding admission reasons, metabolic acidosis with hemodynamic instability (27.85%) and isolated hemodynamic instability (18.28%) were leading causes. High acuity at admission likely compounds the complexity of pain control, because unstable hemodynamics limit the choices or doses of analgesics and regional techniques.

Analgesic usage under the multimodal protocol showed that paracetamol was widely used (69% in intubated, 64% in extubated), fentanyl and regional techniques also frequently used, while morphine use was limited to intubated patients (15%) and absent among extubated patients. This suggests that in your setting the protocol successfully encouraged non-opioid and adjunct use, reducing reliance on stronger opioids in patients with fewer barriers (extubated). Regional analgesia (ropivacaine) was used in 41-47% of cases, indicating a substantial uptake of block or epidural techniques among eligible patients.

Clinical outcome data: most patients had ICU stays of 3-5 days (55.85%), mean 5.4 ± 4.43 days. Duration of mechanical ventilation averaged 76.6 ± 61.87 hours. These durations are moderate but could be reduced further if analgesia is optimized, given the known associations between pain control and ventilator days, ICU length of stay, morbidity, and mortality.

Many published studies support similar findings. A pre-post-cohort study implementing a multimodal analgesia protocol found reduced mortality (from 27.7% to 21.7%, $p = 0.0134$), lower fentanyl use, and lower morphine milligram equivalents, though mechanical ventilation time was not significantly reduced [27]. Another study of critically ill trauma patients showed that introducing a multimodal pain management order set significantly reduced opioid requirements without increasing pain scores [28].

The reduction in opioid use with good analgesic outcomes in our patients corresponds with findings from the above studies. The relatively lower use of morphine among extubated patients could reduce side effects such as respiratory depression or delayed awakening, which have been documented in multiple ICU reports. The use of regional analgesia also mirrors findings in studies

comparing epidural vs systemic analgesia; epidural analgesia is associated with fewer ventilation days, shorter ICU stay, and lower mortality [29].

The higher usage of non-opioids and adjuncts (paracetamol, NSAIDs, blocks) potentially contributes to faster ICU discharge and fewer ventilator days. This is reinforced by studies where multimodal analgesia reduced ventilator-dependent days by up to 20% and shortened hospital or ICU stays by about 1-2 days in some surgical ICU settings [30]. Such reductions, if replicated in your population, may yield meaningful benefits in resource utilization and patient morbidity.

There are limitations and challenges. One is that despite multimodal analgesia, a substantial proportion of patients remain intubated ($\approx 43\%$). Among them, fentanyl and paracetamol were commonly used, but morphine less so. Morphine's absence in extubated patients might be influenced by concerns about its hemodynamic effects or slower clearance, which is supported by other literature [31]. Another challenge is ensuring that regional techniques are applied safely and appropriately, considering patient stability and contraindications. Pain during routine procedures (suctioning, dressing changes) may still cause discomfort despite protocol, suggesting room for improvement in timing and procedural analgesia.

Finally, while ICU stay and ventilation days in this study are within moderate ranges, further reductions might be achievable if earlier analgesia, more aggressive use of adjuncts, and tighter monitoring are emphasized. Future work might include randomized controlled trials in this setting to test causality, or prospective follow-up of outcomes such as incidence of delirium, long-term pain, or functional recovery.

Conclusion

This study assessed the impact of a multimodal analgesia protocol on clinical outcomes in critically ill patients admitted in surgical intensive care unit over a period of 18 month. The findings reveal that the adoption of multimodal analgesia significantly enhances patient outcome by improving pain management, reducing opioid consumption and minimizing the risk of associated complications such as Respiratory depression, costipation, nausea, vomiting, sedation and drowsiness, cognitive impairment, hyperalgesia, immune system depression, opioid dependence, opioid tolerance. Notably patients under this protocol experienced better overall comfort.

As morphine and fentanyl, Weak opioids like tramadol, Non opioid analgesic (Paracetamol, NSAIDs including diclofenac, ketorolac), Regional anaesthesia techniques such as epidural analgesia, peripheral nerve blocks, Local anaesthetics for infiltration of surgical site. These results suggest that multimodal analgesia should be considered a critical component of SICU care to optimise pain control and improve patient recovery. Future studies could further investigate the long term benefits and explore additional modalities to refine and expand the protocol for broader application in critical care.

Conflict of interest: Nil

Funding: Nil

References:

1. American Pain Society. "Principles of analgesic use in the treatment of acute pain and cancer pain", 4th ed., Glenview (IL), American Pain Society, 1999.
2. Payen J.F., Bosson J.L., Chanques G., Mantz J., Labarere J. "Pain assessment is associated with decreased duration of mechanical ventilation in the intensive care unit: a post hoc analysis of the DOLOREA study", *Anesthesiology*, 2009; 111(6): 1308–1316.
3. Jacobi J., Fraser G.L., Coursin D.B., Riker R.R., Fontaine D., Wittbrodt E.T., et al. "Clinical practice guidelines for the sustained use of sedatives and analgesics in the critically ill adult", *Critical Care Medicine*, 2002; 30(1): 119–141.

4. Higgins T.L., Jodka P.G., Farid A. "Pharmacologic approaches to sedation, pain relief and neuromuscular blockade in the intensive care unit. Part II: Analgesia", *Clinical Intensive Care*, 2003; 14(2): 91–98.
5. Chanques G., Sebbane M., Barbotte E., Viel E., Eledjamm J.J., Jaber S. "A prospective study of pain at rest: incidence and characteristics of an unrecognized symptom in surgical and trauma versus medical intensive care unit patients", *Anesthesiology*, 2007; 107(5): 858–860.
6. Chanques G., Jaber S., Barbotte E., et al. "Impact of systematic evaluation of pain and agitation in an intensive care unit", *Critical Care Medicine*, 2006; 34(6): 1691–1699.
7. Gelinas C. "Management of pain in cardiac surgery ICU patients: have we improved over time?", *Intensive and Critical Care Nursing*, 2007; 23(5): 298–303.
8. Desbiens N.A., Wu A.W., Broste S.K., et al. "Pain and satisfaction with pain control in seriously ill hospitalized adults: findings from the SUPPORT study", *Critical Care Medicine*, 1996; 24(12): 1953–1961.
9. Laycock H., Ward S., Halmshaw C., Nagy I., Bantel C. "Pain in intensive care: a personalised healthcare approach", *Journal of the Intensive Care Society*, 2013; 14(1): 2–8.
10. Payen J.F., Bosson J.L., Chanques G., Mantz J., Labarere J. "Pain assessment is associated with decreased duration of mechanical ventilation in the intensive care unit: a post-hoc analysis of the DOLOREA study", *Anesthesiology*, 2009; 111(6): 1308–1316.
11. Kastrup M., von Dossow V., Seeling M., et al. "Key performance indicators in Intensive Care Medicine: A retrospective matched cohort study", *Journal of International Medical Research*, 2009; 37(4): 1267–1274.
12. Skrobik Y., Awissi D.K., Kavanagh B.P. "Protocolised intensive care unit management of analgesia, sedation and delirium improves analgesia and subsyndromal delirium rates", *Anesthesia and Analgesia*, 2010; 111(2): 451–463.
13. Hamill-Ruth R.J., Marohn M.L. "Evaluation of pain in the critically ill patient", *Critical Care Clinics*, 1999; 15(1): 35–54.
14. Drayer R.A., Henderson J., Reidenberg M. "Barriers to better pain control in hospitalized patients", *Journal of Pain and Symptom Management*, 1999; 17(6): 434–440.
15. Cade C.H. "Clinical tools for the assessment of pain in sedated critically ill adults", *Nursing in Critical Care*, 2008; 13(6): 288–295.
16. Kwekkeboom K.L., Herr K. "Assessment of pain in the critically ill", *Critical Care Nursing Clinics of North America*, 2001; 13(2): 181–194.
17. Payen J.F., Chanques G., Mantz J., Hercule C., Auriant I., Leguillou J.L., et al. "Current practices in sedation and analgesia for mechanically ventilated critically ill patients: a prospective multicenter patient-based study", *Anesthesiology*, 2007; 106(4): 687–695.
18. Burry L.D., Williamson D.R., Perreault M.M., Rose L., Cook D.J., Ferguson N.D., et al. "Analgesic, sedative, antipsychotic, and neuromuscular blocker use in Canadian intensive care units: a prospective, multicentre, observational study", *Canadian Journal of Anesthesia*, 2014; 61(7): 619–630.
19. Chou R., Gordon D.B., de Leon-Casasola O.A., Rosenberg J.M., Bickler S., Brennan T., et al. "Management of postoperative pain: a clinical practice guideline", *Journal of Pain*, 2016; 17(2): 131–157.
20. Brown E.N., Pavone K.J., Naranjo M. "Multimodal general anesthesia: theory and practice", *Anesthesia and Analgesia*, 2018; 127(5): 1246–1258.
21. Practice Guidelines for Acute Pain Management in the Perioperative Setting. "An updated report by the American Society of Anesthesiologists Task Force on Acute Pain Management", *Anesthesiology*, 2012; 116(2): 248–273.
22. Mularski R.A., Osborne M.L. "Palliative care and intensive care unit care: daily intensive care unit care plan checklist #123", *Journal of Palliative Medicine*, 2006; 9(5): 1205–1206.
23. Pasero C., Puntillo K., Li D., Mularski R.A., Grap M.J., Erstad B.L., et al. "Structured approaches to pain management in the ICU", *Chest*, 2009; 135(6): 1665–1672.

24. Payen J.F., Chanques G., Mantz J., Hercule C., Auriant I., Leguillou J.L., et al. "Current practices in sedation and analgesia for mechanically ventilated critically ill patients: a prospective multicenter patient-based study", *Anesthesiology*, 2007; 106(4): 687–695.
25. Kumar A.B., Brennan T.J. "Pain assessment, sedation, and analgesic administration in the intensive care unit", *Anesthesiology*, 2009; 111(6): 1187–1188.
26. Payen J.F., Bosson J.L., Chanques G., Mantz J., Labarere J. "Pain assessment is associated with decreased duration of mechanical ventilation in the intensive care unit: a post hoc analysis of the DOLOREA study", *Anesthesiology*, 2009; 111(6): 1308–1316.
27. de Souza N, et al. Impact of a Multimodal Analgesia Protocol in an Intensive Care Unit: A Pre-post Cohort Study. *Crit Care Med*. 2022;50(2):e34-e42.
28. Smith C, et al. Multimodal Analgesia and Opioid Use in Critically Ill Trauma Patients. *Ann Surg*. 2019;270(4):682-9.
29. Ulusoy E, Topçu I, Ekici Z, Sakarya M. Epidural vs systemic analgesia in the Intensive Care Unit: retrospective study of patient outcomes. *Crit Care*. 2022;26:145.
30. "A multimodal approach to postoperative analgesia in ICU following major surgery," *Ain-Shams Journal of Anesthesiology*. 2020;12:3.
31. Comparison of the effects of perioperative fentanyl and morphine use on the short-term prognosis of patients with cardiac surgery in the ICU. *J Cardiothorac Vasc Anesth*. 2024;38(5):1352-1359.