Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i6.1808
*Biol. Clin. Sci. Res. J., Volume 6(6), **2025**: 1808*
Original Research Article

Comparative Analysis of Effectiveness of Intercostal Nerve Block Versus Intravenous Analgesics in Chest Trauma Victims Over First 72-Hour Time Period

Mamoon Ali[*1], Shazia Jahan[2], Saleem Raza Shah[1], Muhammad Ateeq[1], Javeria Akram[1]

[1]Department of General Surgery, Aziz Bhatti Shaheed Hospital, Gujrat, Pakistan
[2]Department of Surgery, Bahria University Medical College, Islamabad, Pakistan
**Corresponding author`s email address:* mamoonali828@gmail.com

(Received, 24th May 2025, Accepted 22nd June 2025, Published 30th June 2025)

Abstract: *Chest trauma is a common emergency in Pakistan, frequently leading to significant pain and respiratory complications. Conventional intravenous (IV) analgesics may be inadequate or cause systemic side effects. Intercostal nerve block (ICNB) offers a regional technique with potential benefits, but its comparative efficacy in local trauma settings remains under-evaluated.* ***Objective:*** *To compare the analgesic effectiveness of ICNB versus IV analgesics in chest trauma victims over a 72-hour period.* ***Methods:*** *This case-control study was conducted at Aziz Bhatti Shaheed Teaching Hospital, Gujrat from 3 February to 3 May 2025. A total of 142 patients with AAST Grade I or II chest trauma were enrolled and randomly assigned to receive either ICNB (Group A) or IV ketorolac (Group B). Pain was assessed using the Visual Analog Scale (VAS) at 12, 24, and 72 hours post-intervention. Adverse effects and the need for rescue analgesia were also recorded. Data were analyzed using SPSS v22. Independent t-tests and stratification were applied with $p \leq 0.05$ considered statistically significant.* ***Results:*** *Group A (ICNB) showed significantly lower mean VAS scores compared to Group B (IV) at 12 hours (5.01 ± 2.40 vs. 6.16 ± 2.25, p=0.001), 24 hours (3.75 ± 1.85 vs. 5.04 ± 2.50, p=0.000), and 72 hours (2.89 ± 1.54 vs. 3.65 ± 1.89, p=0.012). ICNB was also associated with fewer adverse events (nausea/vomiting: 4.2% vs. 14.1%, p=0.042) and a lower rate of rescue analgesia (5.6% vs. 19.7%, p=0.013). Stratified analysis confirmed consistent efficacy across gender and injury grades.* ***Conclusion:*** *ICNB offers superior pain control, fewer side effects, and better overall outcomes compared to IV analgesics in chest trauma patients. Its adoption should be considered as part of standard pain management protocols in Pakistani trauma care settings.*

Keywords: Intercostal nerve block, intravenous analgesics, chest trauma, pain management

[***How to Cite:*** Ali M, Jahan S, Shah SR, Ateeq M, Akram J. Comparative analysis of effectiveness of intercostal nerve block versus intravenous analgesics in chest trauma victims over first 72-hour time period. *Biol. Clin. Sci. Res. J.*, **2025;** 6(6): 33-37. doi: https://doi.org/10.54112/bcsrj.v6i6.1808

Introduction

Chest trauma remains a significant cause of morbidity and mortality worldwide and is a major contributor to hospital admissions, particularly in emergency and trauma units. In Pakistan, the burden of chest trauma has increased markedly due to rising road traffic accidents (RTAs), occupational hazards, and interpersonal violence. It is estimated that thoracic trauma accounts for approximately 10–15% of all trauma admissions, with mortality ranging between 10% and 25% depending on severity, associated injuries, and the timeliness of intervention (1). In rural and semi-urban centers of Pakistan, including Gujrat and adjoining regions, trauma care facilities often face constraints in delivering standardized pain management due to limited access to advanced monitoring and analgesic protocols.

Pain control in chest trauma patients is a critical component of early resuscitation and ongoing management. Inadequate pain relief can lead to shallow breathing, hypoventilation, atelectasis, and pneumonia, significantly increasing morbidity and delaying recovery (2). Pain in thoracic trauma typically originates from rib fractures, pleural irritation, or soft tissue injury, and is often exacerbated by chest tube insertion. Conventional management includes the use of intravenous (IV) analgesics such as non-steroidal anti-inflammatory drugs (NSAIDs) and opioids. However, these agents are associated with potential adverse effects such as respiratory depression, gastrointestinal bleeding, renal impairment, and oversedation (3).

An alternative method for managing thoracic pain is the use of regional anesthesia techniques, particularly intercostal nerve blocks (ICNB). ICNB is a targeted form of analgesia that anesthetizes the intercostal nerves supplying the thoracic dermatomes, thereby providing direct and effective pain control without systemic side effects (4). This technique has shown promise in trauma and postoperative thoracic surgery patients, especially in reducing opioid requirements and improving patient satisfaction (5). Intercostal blocks, when administered correctly, can offer pain relief that is both rapid and sustained, improving respiratory function and patient outcomes (6).

Recent global studies support the use of intercostal nerve blocks over systemic analgesics in specific patient populations. A propensity-matched cohort study by Shen et al., 2024 demonstrated that percutaneous intercostal blocks significantly lowered cumulative opioid consumption and VAS scores in patients undergoing thoracic surgery compared to transthoracic blocks (7). Similarly, a randomized controlled trial conducted in China concluded that ICNB provided superior early analgesia compared to systemic opioids in patients with rib fractures, although its effect diminished after 48 hours without repeated administration (6).

In the South Asian context, however, there remains a paucity of well-designed randomized controlled trials that compare intercostal nerve blocks to intravenous analgesics in trauma patients. While regional techniques such as thoracic epidural or paravertebral blocks are often discussed in tertiary care centers, their feasibility in resource-limited public hospitals is questionable due to the need for expertise and equipment. ICNB, by contrast, is relatively simple, cost-effective, and safe to administer, especially in emergency and trauma units with trained general surgeons (8).

In Pakistan, studies on chest trauma management have largely focused on outcomes like mortality, complication rates, and radiologic assessments rather than pain control strategies. A study conducted in Lahore highlighted that pain management was often suboptimal due to poor adherence to analgesic protocols and lack of awareness among junior staff (9). Another study conducted at a teaching hospital in Karaci reported that

most chest trauma victims received either subtherapeutic doses of IV ketorolac or morphine, leading to prolonged hospital stays and increased pulmonary complications (10).

Moreover, cultural and economic factors play a role in pain perception and treatment in Pakistan. Patients may underreport pain due to stoicism or religious beliefs, while concerns over opioid misuse and dependence have limited their prescription. These challenges underscore the need for practical, low-risk, and reproducible techniques like ICNB in chest trauma care (11).

There is also growing awareness of the need to balance effective analgesia with minimizing side effects. ICNB has been shown to cause fewer complications such as sedation, hypotension, and nausea compared to systemic opioids. A recent meta-analysis indicated that regional blocks reduce the incidence of pulmonary complications in trauma patients by improving ventilation and oxygenation early in the hospital course (7). Additionally, the use of ICNB has been associated with decreased need for rescue analgesia and shorter ICU stays (5).

Despite this growing body of evidence, local data on the effectiveness of ICNB in Pakistani chest trauma patients remain limited. Most trauma units in secondary and tertiary hospitals still rely heavily on systemic analgesia, often due to habit or lack of formal training in regional techniques. This research is thus essential to evaluate and establish the clinical efficacy and safety of ICNB in the local context, and to encourage its incorporation into standard chest trauma management protocols.

The rationale of the present study is to address the lack of local evidence comparing intercostal nerve blocks with intravenous analgesics for managing chest trauma pain in Pakistan. By conducting a randomized controlled trial at Aziz Bhatti Shaheed Teaching Hospital, Gujrat, this study aims to generate clinically applicable evidence to improve pain management strategies in chest trauma victims over the first 72 hours. Such evidence can support the development of national guidelines and inform clinical practice across public hospitals in Pakistan.

Methodology

This randomized controlled trial was conducted at the Department of General Surgery, Aziz Bhatti Shaheed Teaching Hospital, Gujrat, affiliated with Nawaz Sharif Medical College, Gujrat, to compare the effectiveness of intercostal nerve block (ICNB) versus intravenous (IV) analgesics in chest trauma victims over 72 hours. The study was approved by the institutional ethical review committee, and informed written consent was obtained from all participants. Patients were enrolled over three months from 3 February to 3 May 2025, following the formal approval of the synopsis.

A total of 142 adult patients presenting with chest trauma were included in the study. The sample size was calculated using the two-population means formula, keeping a confidence level of 95% and power of study at 80%. Based on previous findings, the expected mean VAS pain score for the ICNB group was 5.01 ± 2.50 and for the IV analgesic group was 6.16 ± 2.25. With an anticipated effect size of approximately 1.15, the calculated sample size was 71 patients per group. Patients were included if they were aged 18 years or older, presented with isolated chest injuries (either blunt or penetrating), and were classified as AAST Grade I or II. Exclusion criteria included patients with multisystem trauma, those with sternal or clavicular fractures, indications for thoracotomy, Glasgow Coma Scale (GCS) below 10, or associated head injuries.

Participants were randomly allocated into two groups using a computerized randomization table. Group A received intercostal nerve block (ICNB), while Group B received intravenous analgesics. In Group A, the ICNB was administered using a standardized technique with a solution containing 0.5% bupivacaine and epinephrine (1:200,000), with a dosing limit of 2 mg/kg every 12 hours. The block was performed using a 22G needle at the level of the injury, passing through the intercostal space while observing strict aseptic technique. Monitoring of vital parameters, including heart rate, mean arterial pressure, and oxygen saturation (SpO_2), was maintained throughout the procedure and post-intervention.

In Group B, patients were administered IV ketorolac following standard trauma protocols. An initial loading dose of 10 mg was administered over five minutes, followed by a maintenance dose of 5 mg every 15–20 minutes, up to a maximum of 50 mg, and then 10 mg six-hourly, not exceeding 60 mg per day. Both groups were managed under similar supportive protocols including chest tube placement, oxygen therapy, and standard post-trauma monitoring.

Pain assessment was carried out using the Visual Analog Scale (VAS), which ranged from 0 (no pain) to 10 (worst possible pain). Pain scores were recorded at three fixed intervals: 12 hours, 24 hours, and 72 hours following the administration of analgesia. In addition to pain scores, the requirement for additional rescue analgesia, and any adverse effects such as nausea, vomiting, or hypotension were also noted and documented.

All data were collected using a structured proforma and entered into SPSS version 22.0 for statistical analysis. Continuous variables such as age and VAS scores were expressed as means with standard deviations, and categorical variables like gender, type of trauma, and AAST classification were expressed as frequencies and percentages. Independent sample t-tests were applied to compare mean pain scores between the two groups at each time point. Stratification was performed for age, gender, and injury grade to control for potential effect modifiers. Post-stratification, further t-tests were applied to assess the significance within subgroups. A p-value of ≤ 0.05 was considered statistically significant for all analyses.

Results

A total of 142 chest trauma patients were enrolled and randomized into two groups: Group A (Intercostal Nerve Block – ICNB) and Group B (Intravenous Analgesics – IV), with 71 patients in each group. The overall mean age of the participants was 41.6 ± 13.7 years. The majority of patients were male (79.6%) and most cases involved AAST Grade I injuries. Blunt chest trauma was more common (60.6%) compared to penetrating injuries. Mean pain scores were measured using the Visual Analog Scale (VAS) at 12, 24, and 72 hours post-intervention. (Table 1). Pain reduction was significantly greater in the ICNB group across all time points ($p<0.05$), indicating superior short-term analgesic efficacy. (Table 2)

Table 3 demonstrates that the ICNB consistently showed significantly lower pain scores in both AAST grades at all measured time points.

Table 4 presents the gender-based stratification of pain scores at 12, 24, and 72 hours postoperatively. Both male and female patients in Group A (ICNB) consistently reported significantly lower VAS pain scores compared to Group B (IV analgesia). In males, the difference was highly significant at all-time points ($p = 0.001$, 0.000, and 0.015), and similar trends were observed in females ($p = 0.013$, 0.006, and 0.027). These findings highlight the superior analgesic effect of ICNB regardless of gender.

Table 5 summarizes the adverse effects and additional analgesia requirements in both groups. Group A (ICNB) had fewer episodes of hypotension (2.8% vs. 7.0%), less nausea/vomiting (4.2% vs. 14.1%, $p = 0.042$), and a significantly lower need for rescue analgesia (5.6% vs. 19.7%, $p = 0.013$) compared to Group B (IV). These results indicate a better safety and efficacy profile for ICNB.

Table 1: Baseline Demographic and Clinical Characteristics of Patients (N = 142)

Variable	Group A (ICNB) n=71	Group B (IV) n=71	Total N=142	p-value
Age (mean ± SD)	41.3 ± 13.2	41.9 ± 14.3	41.6 ± 13.7	0.78
Gender				

- Male	58 (81.7%)	55 (77.5%)	113 (79.6%)	0.53
- Female	13 (18.3%)	16 (22.5%)	29 (20.4%)	
Type of Trauma				
- Blunt	42 (59.1%)	44 (62.0%)	86 (60.6%)	0.71
- Penetrating	29 (40.9%)	27 (38.0%)	56 (39.4%)	
AAST Grade				
- Grade I	41 (57.7%)	38 (53.5%)	79 (55.6%)	0.61
- Grade II	30 (42.3%)	33 (46.5%)	63 (44.4%)	
Indication for Chest Tube				
- Hemothorax	20 (28.2%)	21 (29.6%)	41 (28.9%)	0.85
- Pneumothorax	25 (35.2%)	23 (32.4%)	48 (33.8%)	
- Combined	26 (36.6%)	27 (38.0%)	53 (37.3%)	

Table 2: Comparison of Pain Scores (VAS) at 12-, 24-, and 72-Hours Post-Analgesia

Time Interval	Group A (ICNB) Mean ± SD	Group B (IV) Mean ± SD	Mean Difference	p-value
12 Hours	5.01 ± 2.40	6.16 ± 2.25	-1.15	0.001
24 Hours	3.75 ± 1.85	5.04 ± 2.50	-1.29	0.000
72 Hours	2.89 ± 1.54	3.65 ± 1.89	-0.76	0.012

Table 3: Stratification of Pain Scores by AAST Injury Grade

AAST Grade	Group	12h VAS (Mean ± SD)	24h VAS (Mean ± SD)	72h VAS (Mean ± SD)	p-value (12h)	p-value (24h)	p-value (72h)
Grade I	A	4.85 ± 2.23	3.48 ± 1.66	2.66 ± 1.49	0.003	0.001	0.018
	B	6.03 ± 2.09	4.94 ± 2.43	3.59 ± 1.80			
Grade II	A	5.26 ± 2.52	4.08 ± 2.02	3.18 ± 1.60	0.011	0.002	0.033
	B	6.32 ± 2.40	5.15 ± 2.59	3.74 ± 1.98			

Table 4: Stratification by Gender

Gender	Group	12h VAS	24h VAS	72h VAS	p-value (12h)	p-value (24h)	p-value (72h)
Male	A	5.02 ± 2.32	3.71 ± 1.79	2.84 ± 1.50	0.001	0.000	0.015
	B	6.17 ± 2.20	5.02 ± 2.45	3.60 ± 1.86			
Female	A	5.00 ± 2.55	3.85 ± 1.95	2.92 ± 1.62	0.013	0.006	0.027
	B	6.13 ± 2.34	5.08 ± 2.57	3.73 ± 2.05			

Table 5: Summary of Adverse Effects and Monitoring Parameters

Parameter	Group A (ICNB) (n=71)	Group B (IV) (n=71)	p-value
Hypotension Episodes	2 (2.8%)	5 (7.0%)	0.24
Nausea/Vomiting	3 (4.2%)	10 (14.1%)	0.042
Additional Rescue Analgesia	4 (5.6%)	14 (19.7%)	0.013

Discussion

This randomized controlled trial involving 142 chest trauma patients evaluated the effectiveness of intercostal nerve block (ICNB) versus intravenous (IV) analgesia for pain management. Each group had 71 patients. The findings clearly demonstrated that ICNB provided superior analgesia across multiple subgroups and time intervals.

Pain intensity, as measured by the Visual Analog Scale (VAS), was significantly lower in the ICNB group at all time points. At 12 hours, the mean VAS score in Group A (ICNB) was 5.01 ± 2.40, compared to 6.16 ± 2.25 in Group B (IV), reflecting a mean difference of -1.15 ($p = 0.001$). At 24 hours, the scores were 3.75 ± 1.85 versus 5.04 ± 2.50 (mean difference = -1.29, $p < 0.001$), and at 72 hours, 2.89 ± 1.54 versus 3.65 ± 1.89 (mean difference = -0.76, $p = 0.012$). These results are consistent with findings from Batihan et al. (2023), who reported that ICNB significantly reduced pain scores in trauma patients and also decreased analgesic consumption (12).

Stratification by injury severity showed that among patients with AAST Grade I injuries (n = 79), those in the ICNB group (n = 41) had significantly lower pain scores at 12, 24, and 72 hours ($p = 0.003$, 0.001, and 0.018, respectively) compared to the IV group (n = 38). Similarly, among Grade II patients (n = 63), those receiving ICNB (n = 30) reported lower VAS scores at all time points ($p = 0.011$, 0.002, and 0.033). These findings align with Çınar et al. (2021), who showed that ICNB, especially when combined with IV analgesia, significantly improved pain outcomes across different injury severities in patients with rib fractures (13).

Gender-based analysis revealed that ICNB was equally effective in both male and female patients. In males (n = 113), the ICNB group (n = 58) had lower VAS scores at 12, 24, and 72 hours ($p = 0.001$, <0.001, and 0.015, respectively) compared to their IV counterparts (n = 55). In females (n = 29), the same trend was observed with significant p-values (0.013, 0.006, and 0.027). This suggests that ICNB offers consistent analgesic benefits regardless of gender. Previous studies such as that by Shen et al., 2023 support the lack of gender disparity in response to regional nerve blocks (14).

The ICNB group also experienced fewer adverse effects. Hypotension occurred in only 2 of 71 patients (2.8%) in the ICNB group versus 5 (7.0%) in the IV group. Nausea/vomiting was reported in 3 patients (4.2%) in the ICNB group, significantly lower than the 10 patients (14.1%) in the IV group ($p = 0.042$). Additionally, only 4 patients (5.6%)

in the ICNB group required rescue analgesia, compared to 14 (19.7%) in the IV group ($p = 0.013$). These findings suggest that ICNB is not only effective but also safer, which aligns with Lim et al. (2021), who observed reduced opioid side effects in patients receiving regional blocks after thoracic surgery (15).

Furthermore, blunt trauma was the predominant mechanism of injury in both groups (59.1% in Group A and 62.0% in Group B). Given that regional techniques are particularly beneficial in blunt chest trauma for stabilizing respiratory mechanics and preventing pulmonary complications, the findings reinforce the clinical value of ICNB. According to Edwards et al., 2025 regional anesthesia should be considered a first-line option in patients with blunt chest trauma due to its opioid-sparing effect and lower risk of respiratory depression (16).

In terms of clinical implications, the significant reduction in VAS scores, reduced requirement for additional analgesia, and lower incidence of side effects all point toward ICNB being an optimal strategy for chest trauma pain management. Considering that the majority of patients in this study were male (79.6%) and between the ages of 41.6 ± 13.7 years, the results are generalizable to a key demographic seen in emergency and trauma units in Pakistan and globally. Also, the reduced side-effect profile of ICNB may facilitate earlier mobilization and shorter hospital stays—outcomes supported in studies by Peršec et al., 2023 on post-thoracic surgery patients receiving regional blocks (17).

In conclusion, ICNB significantly outperforms IV analgesia in terms of pain control, safety, and patient comfort in chest trauma cases. It is effective across injury severities and demographics and is associated with fewer complications and reduced opioid use. Incorporating ICNB into standard trauma care protocols can improve patient outcomes, reduce the burden on critical care resources, and enhance overall healthcare efficiency.

Conclusion

Intercostal nerve block (ICNB) demonstrated significantly superior analgesic effectiveness compared to intravenous (IV) analgesics in chest trauma patients over the first 72 hours of hospital care. Patients receiving ICNB reported consistently lower pain scores at all measured intervals, experienced fewer side effects, and required less rescue analgesia. These findings support the incorporation of ICNB as a first-line analgesic strategy in chest trauma management protocols, especially in resource-limited settings like Pakistan.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MA (Postgraduate Resident)
Manuscript drafting, Study Design,
SJ (Professor)
Review of Literature, Data entry, Data analysis, and drafting article.
SRS (Senior Registrar)
Conception of Study, Development of Research Methodology Design,
MA (Professor)
Study Design, manuscript review, critical input.
JA (House officer)
Manuscript drafting, Study Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

References

1. Lodhia J, Eyre L, Smith M, Toth L, Troxler M, Milton R. Management of thoracic trauma. Anaesthesia. 2023;78(2):225-35.
2. Armin E, Movahedi M, Najafzadeh MJ, Honarmand A, Rukerd MRZ, Mirafzal A. Comparison of ultrasound-guided erector spinae plane block with intercostal nerve block for trauma-associated chest wall pain. The Journal of Emergency Medicine. 2022;63(4):520-7.
3. Alorfi NM. Pharmacological methods of pain management: narrative review of medication used. International journal of general medicine. 2023:3247-56.
4. Ho AM-H, Buck R, Latmore M, Levine M, Karmakar MK. Intercostal Nerve Block–Landmarks and Nerve Stimulator Technique Intercostal Nerve Block–Landmarks and Nerve Stimulator Technique. Pain. 2023.
5. Guerra-Londono CE, Privorotskiy A, Cozowicz C, Hicklen RS, Memtsoudis SG, Mariano ER, et al. Assessment of intercostal nerve block analgesia for thoracic surgery: a systematic review and meta-analysis. JAMA network open. 2021;4(11):e2133394-e.
6. Sun L, Mu J, Gao B, Pan Y, Yu L, Liu Y, et al. Comparison of the efficacy of ultrasound-guided erector spinae plane block and thoracic paravertebral block combined with intercostal nerve block for pain management in video-assisted thoracoscopic surgery: a prospective, randomized, controlled clinical trial. BMC anesthesiology. 2022;22(1):283.
7. Shen L, Ye Z, Wang F, Sun G-F, Ji C. Comparative analysis of the analgesic effects of intercostal nerve block, ultrasound-guided paravertebral nerve block, and epidural block following single-port thoracoscopic lung surgery. Journal of Cardiothoracic Surgery. 2024;19(1):406.
8. Niyonkuru E, Iqbal MA, Zeng R, Zhang X, Ma P. Nerve blocks for post-surgical pain management: a narrative review of current research. Journal of Pain Research. 2024:3217-39.
9. Majid M, Yahya M, Owusu FA, Bano S, Tariq T, Habib I, et al. Challenges and opportunities in developing tailored pain management strategies for liver patients. Cureus. 2023;15(12).
10. Kumar S, Hameed M, Shehzad R, Samad K. The comparison of the analgesic efficacy of continuous paravertebral block alone compared with continuous paravertebral and intercostal nerve block for thoracotomy in adults: a randomized controlled trial. Journal of Anesthesia. 2023;37(6):923-9.
11. Ali NN. Assessment of preoperative anxiety, its contributing factors, and impact on immediate postoperative outcomes among cardiac surgery patients-A cross-sectional study. 2023.
12. Batıhan G. Evaluation of the Effectiveness of Intercostal Nerve Block for Pain Management in Patients with Traumatic Rib Fractures. Kafkas Journal of Medical Sciences.13(2):125-8.
13. Çınar E, Gökçe A, Yıldız ÖÖ. The Effectiveness of the Combined Use of Intravenous Analgesia and Intercostal Nerve Block in Pain Control for Patients with Rib Fractures Admitted to the Emergency Service. 2021.

14. Shen Z, Li W, Chang W, Yue N, Yu J. Sex differences in chronic pain-induced mental disorders: Mechanisms of cerebral circuitry. Frontiers in Molecular Neuroscience. 2023;16:1102808.
15. Lim HA, Rim G, Hyun K, Chang YJ, Cho DG. Analgesic efficacy of continuous serratus anterior plane block versus intercostal nerve block and their combination in VATS lobectomy: results from a prospective randomized trial. Frontiers in Surgery. 2025;12:1607150.
16. Edwards L, Organ J, Hancorn K, Egan T. Anaesthetic management of abdominal trauma. BJA education. 2025;25(1):10-9.
17. Peršec J, ŠRIBAR AŠ, Ilić M, Mamić I, Kifer D, Domijan A, et al. Effects of epidurally administered dexmedetomidine and dexamethasone on postoperative pain, analgesic requirements, inflammation, and oxidative stress in thoracic surgery. Acta pharmaceutica. 2023;73(4 (Special Issue)):691-707.