Journal of Cardiothoracic and Vascular Anesthesia 000 (2026) 1–5

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Original Article

Influence of Preoperative Anxiety on Postoperative Opioid Consumption and Pain Scores in Adults Undergoing Elective Cardiac Surgery

Iuliana Marinela Lupu, MD[*,1], Cristina Bianca Robu, MD[*], Mona Momeni, MD, PhD[*,†,‡], Céline Khalifa, MD, PhD[*,†,‡]

[*]*Department of Anesthesiology, Cliniques universitaires Saint-Luc, Brussels, Belgium*
[†]*Institute of Experimental and Clinical Research, UCLouvain, Brussels, Belgium*
[‡]*Institute of NeuroScience, UCLouvain, Brussels, Belgium*

Objectives: To evaluate whether preoperative anxiety was associated with higher opioid consumption and higher pain scores after cardiac surgery.
Design: A prospective cohort study.
Setting: University hospital, single-center study.
Participants: A total of 220 adult patients undergoing their first elective cardiac surgery by sternotomy.
Interventions: Preoperative anxiety (A) was assessed the day before surgery using the Hospital Anxiety and Depression Scale (HADS). In-hospital opioid consumption and daily assessments of postoperative pain using a visual analog scale (VAS) were performed until 5 days after surgery. A HADS-A score of >7 of 21 was considered abnormal.
Measurements and Main Results: Patients with or without anxiety were compared using the Mann-Whitney U test and the chi-square test. Linear regression analyses assessed the relationship between preoperative anxiety and postoperative opioid consumption, as well as VAS scores, at day (D) 1, D2, and D5. Of the patients, 186 of 220 (84.5%) completed the HADS-A, and 90 of 186 (48.4%) had preoperative signs of anxiety. There was no significant difference in terms of age between patients with and without anxiety. Twenty of 31 female patients (64.5%) had anxiety versus 70 of 155 men (45.2%) ($p = 0.049$). There was no difference in in-hospital opioid consumption ($p = 0.311$). However, anxious patients described significantly higher VAS scores at several moments from D1 to D5 after surgery.
Conclusions: A significant proportion of our cardiac surgery patients, especially women, experienced preoperative anxiety. Although the latter did not influence in-hospital opioid consumption, anxiety had a significant impact on postoperative VAS pain scores. Screening and management of anxiety before elective cardiac surgery could improve postoperative recovery by reducing pain severity.

Keywords: anxiety; cardiac surgery; postoperative delirium; postoperative pain; opioid consumption

POSTOPERATIVE PAIN FOLLOWING CARDIAC SURGERY represents a significant challenge for anesthesiologists and health care providers. Proper management of this pain is essential to ensure optimal recovery and minimize complications that could affect patient outcomes. Indeed, inadequate pain management can lead to prolonged recovery, increased morbidity, and a higher risk of complications.[1] However, despite advancements in surgical techniques and postoperative analgesia, pain management remains a persistent issue, especially after sternotomy, which is still frequently performed in cardiac surgeries. The sternum, which is richly innervated by intercostal nerves, is particularly susceptible to injury.[2] Along with the typical inflammatory responses triggered by tissue damage, the direct injury to the skin and sternum is regarded as a main source of pain perception in the postoperative period.

However, the perception of pain is highly subjective, and several risk factors can modulate this experience. Indeed,

[1]*Address correspondence to* Iuliana Marinela Lupu, MD, Cliniques universitaires Saint-Luc, 10 avenue Hippocrate 1200 Brussels, Belgium.
E-mail address: iuliana.lupu@saintluc.uclouvain.be (I.M. Lupu).

https://doi.org/10.1053/j.jvca.2026.02.007

postoperative pain is influenced by not only physiological factors but also psychological and psychosocial elements, including preoperative anxiety.[3,4] Preoperative anxiety, a common emotional response in patients undergoing both minor and major surgeries, is influenced by various sociodemographic factors, such as age, sex, educational level, and the amount of information provided prior to surgery.[5] Cardiac surgery patients are particularly susceptible to increased anxiety due to the inherent risks associated with these procedures, which often involve significant concerns about potential complications. Identifying patients with high anxiety levels before surgery is mandatory to enhance postoperative recovery and improve patient satisfaction.[3,6]

In this study, we aimed to explore the potential influence of preoperative anxiety on postoperative opioid consumption and pain severity following cardiac surgery. Our main objective was to deepen our understanding of how psychosocial factors influence recovery and pain management in our department, in order to further guide strategies to enhance patient care. Based on prior evidence indicating that anxiety can modulate postoperative pain perception, we hypothesized that patients with higher levels of preoperative anxiety would require more postoperative opioid analgesia and would report higher postoperative pain scores.

Methods

This study is a secondary analysis of a prospective cohort study on perioperative predictors of delirium after cardiac surgery.[7,8] The initial project was approved in September 2018 by the Comité d'Ethique Hospitalo-Facultaire of Cliniques universitaires Saint-Luc (B403201837550, Brussels, Belgium—chairman: Pr. J-M Maloteaux) and registered in ClinicalTrails.gov (NCT03706989) before the start of the trial. Written informed consent was obtained from all patients who underwent their first elective cardiac surgery with normothermic cardiopulmonary bypass. The entire study protocol, including inclusion and exclusion criteria, flow diagram of inclusions, and anesthesia and cardiopulmonary bypass protocols, has been reported previously.[7,8] Particularly related to the present study, patients with psychiatric disorders or preoperative delirium were excluded from the trial.

Preoperative Questionnaires

The day before surgery, alongside the preoperative anesthesia evaluation, all the enrolled patients filled several questionnaires according to the study protocol:

(1) Preoperative global cognition was assessed by performing the Mini-Mental State Examination.[9]
(2) Preoperative anxiety and depression symptoms were assessed using the Hospital Anxiety and Depression Scale (HADS). HADS is a self-rated patient outcome tool developed to screen anxiety and depression symptoms that might occur during the week before answering the questionnaire.[10] Each of the 14 items of this scale is rated on a range from 0 to 3, with a maximum score of 21 for each subscale (A for Anxiety, D for Depression). A score <7 of 21 is considered normal, 8 to 10 of 21 is considered moderate anxiety symptoms, and ≥ 11 of 21 is considered severe anxiety symptoms. For the purpose of this study, a HADS-A or HADS-D >7 of 21 was considered pathological.
(3) Preoperative quality of sleep was evaluated using the Pittsburgh Sleep Quality Index (PSQI). The PSQI is a self-reported tool developed to assess sleep quality over a 1-month time interval.[11] Each item of this questionnaire is rated on a range from 0 to 3, with higher scores indicating more sleep disturbances. A score >5 of 21 is considered pathological.

Postoperative Opioid Consumption, Pain Management, and Pain Evaluation

Postoperative analgesia was provided by a patient-controlled analgesia pump containing either morphine or piritramide, associated with acetaminophen (1 g/6 h, intravenously or per os), systematically for the first 2 days, then as pro re nata. If no contraindication, ibuprofen (400 mg/8 h) was administered for the first 2 days, then as pro re nata. Whenever the patient was not able to take oral ibuprofen, intravenous ketorolac (30 mg) up to a maximum of 3 times a day was used instead.

In-hospital opioid consumption (morphine or piritramide) was recorded. Daily assessment of postoperative pain severity at rest as well as during mobilization was performed by using a visual analog scale (VAS) ranging from 0 (no pain) to 10 (most severe pain) before noon until 5 days after surgery.

Statistical Analyses

A Kolmogorov-Smirnov test was used to evaluate the normality of the data. Continuous variables are presented as median [25th percentile, 75th percentile], and categorical variables are expressed as numbers (percentages). Comparison of continuous variables between patients with and without preoperative anxiety was performed using a Mann-Whitney U test. A Pearson chi-square test was used to compare categorical variables between the 2 groups.

Univariable linear regression analyses assessed the relationship between preoperative significant signs of anxiety (HADS >7/21) and postoperative opioid consumption and postoperative pain scores at days 1, 2, and 5 after surgery.

A p-value <0.05 was considered statistically significant.

All statistical analyses were performed using IBM SPSS Statistics version 27 (SPSS, Inc.).

Results

The flow diagram of this study is presented in Figure 1. In total, 186 patients (84.5% of the cohort) completed the anxiety-related items of the HADS. Among them, 90 patients

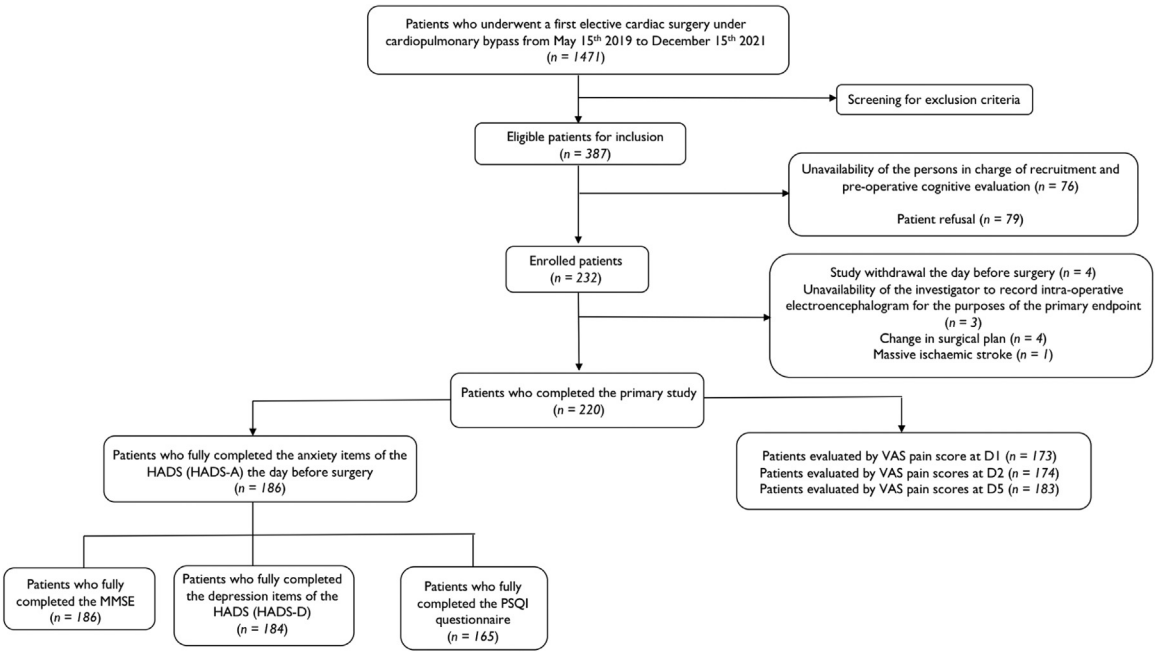

Fig 1. Flow diagram of the study. D, postoperative day; HADS-A, Hospital Anxiety and Depression Scale−Anxiety part; HADS-D, Hospital Anxiety and Depression Scale−Depression part; PSQI, Pittsburg Sleep Quality Index; VAS, visual analog scale.

(48.4%) had preoperative signs of anxiety. Preoperative relevant characteristics of the patients with and without anxiety are detailed in Table 1. There was no significant difference in terms of age, EuroSCORE II (European System for Cardiac Operative Risk Evaluation), or complexity of the planned surgery between anxious and nonanxious patients. There was also no statistically significant difference regarding preoperative global cognition or educational level between the 2 groups.

Among the 186 patients who filled out the anxiety-related items of the questionnaire, 155 patients were male, and 31 were female. There was a poor but still significantly higher

Table 1
Preoperative Characteristics of Patients With and Without Preoperative Anxiety

Characteristic	No Anxiety (n = 96)	Anxiety (n = 90)	p-Value
Age, y	69 [62, 76]	64.5 [57, 74]	0.071[a]
Sex, female	11 (11.5)	20 (22.2)	0.049*,[b]
EuroSCORE II, %	1.6 [1.0, 2.5]	1.5 [0.8, 2.7]	0.311[a]
MMSE, /30	28.5 [27, 29]	29 [28, 29]	0.445[a]
Lower educational level (<9 years)	23 (25.8) (n = 89)	23 (26.7) (n = 86)	0.892[b]
Chronic use of benzodiazepines	4 (4.2)	16 (17.8)	0.003*,[b]
Chronic use of antidepressants	8 (8.3)	12 (13.3)	0.271[b]
HADS-D >7/21	5 (5.3) (n = 95)	24 (27.0) (n = 89)	<0.001*,[b]
PSQI >5/21	49 (55.7) (n = 88)	59 (76.6) (n = 77)	0.005*,[b]
Anticipated anesthesia consultation	14 (14.6)	13 (14.4)	0.979[b]
Premedication prior to anesthesia	77 (80.2)	66 (73.3)	0.266[b]
Complexity of planned surgery			0.174[b]
Isolated CABG	44 (45.8)	42 (46.7)	
Single non-CABG	15 (15.6)	23 (25.6)	
2 interventions	27 (28.1)	15 (16.7)	
≥3 interventions	10 (10.4)	10 (11.1)	

Continuous variables are expressed as medians [25th percentile, 75th percentile]. Categorical variables are expressed as numbers (percentages). The number of patients with available data is in parentheses.

Abbreviations: CABG, coronary artery bypass grafting; EuroSCORE, European System for Cardiac Operative Risk Evaluation; HADS, Hospital Anxiety and Depression Scale; MMSE, Mini-Mental State Examination; PSQI, Pittsburgh Sleep Quality Index.

* $p < 0.05$. P-values refer to group comparison by: [a]Mann-Whitney U test or [b]Pearson chi-square test. Low educational level (< 9 years) corresponds to patients who did not finish regular school in our country (Belgium).

proportion of female patients with preoperative signs of anxiety before surgery (70/155 male patients [45.2%] *v* 20/31 female patients [64.5%]; p = 0.049).

Anxious patients more frequently had a history of chronic use of benzodiazepines (16/90 anxious patients [17.8%] *v* 4/96 nonanxious patients [4.2%]; p = 0.003). Anxious patients more frequently presented with preoperative sleep disturbances (59/77 anxious patients with PSQI >5 [76.6%] *v* 49/88 nonanxious patients with PSQI >5 [55.7%]; p = 0.005) and preoperative signs of depression (24/89 [27.0%] anxious patients with HADS-D >7/21 *v* 5/95 [5.3%] nonanxious patients with HADS-D >7/21; p < 0.001).

There was no statistically significant difference regarding postoperative in-hospital opioid consumption between patients with and without preoperative anxiety (median [P_{25}, P_{75}]; 51.9 [30.0, 72.0] mg for anxious *v* 41.3 [22.0, 72.3] mg for nonanxious patients; p = 0.126).

Univariable linear regression analyses showed that patients with preoperative signs of anxiety described significantly higher VAS pain scores at different timings on postoperative days 2 and 5 after surgery (Table 2).

In accordance with our hypothesis, anxious patients reported higher postoperative pain scores, although this did not translate into increased opioid consumption.

Discussion

This study revealed that 48.4% of our patients undergoing elective cardiac surgery experienced at least moderate levels of preoperative anxiety. This prevalence aligns with previous findings in a broader surgical population, as demonstrated by previous systematic reviews, which reported a pooled preoperative anxiety prevalence ranging from 48% to 55.7%.[12,13] In the specific context of cardiac surgery, a study using the Amsterdam Preoperative Anxiety and Information Scale reported that 28% of patients experienced high levels of preoperative anxiety.[14] Although the anxiety assessment tools used are different among the studies, demographic characteristics and cultural contexts might explain discrepancies in the prevalence of preoperative anxiety, which remains a concern in perioperative care.

In our clinical series, female patients were significantly more likely to report preoperative anxiety. Although our sample size warrants cautious interpretation, this trend is well supported by existing literature identifying female sex as an independent predictor of heightened preoperative anxiety.[13,15,16] Other established risk factors include younger age, higher educational attainment, cognitive impairment, and the type of surgical procedure.[14,17,18] However, in our study, the abovementioned latter factors were not identified as having significant influences, prompting us to consider other psychosocial or clinical factors that may have a more substantial impact. Interestingly, our results revealed that individuals with a history of chronic benzodiazepine or antidepressant use were more vulnerable, possibly reflecting underlying psychiatric comorbidities. Furthermore, a statistically significant association was also found between preoperative anxiety and sleep disturbances. This finding is consistent with the conclusion of a recent systematic review and meta-analysis by Butris et al.[19] We also observed a significant association between preoperative anxiety and depressive symptoms, emphasizing the frequent coexistence of these psychological states and underscoring the importance of implementing routine and comprehensive preoperative mental health screening to better identify and address these co-occurring issues.

Our study was designed to test the hypothesis that preoperative anxiety would lead to increased postoperative opioid use and higher pain intensity.

Our findings confirmed a significant relationship between preoperative anxiety and postoperative pain perception. Indeed, patients with higher preoperative anxiety levels reported significantly elevated pain scores on the VAS at postoperative days 2 and 5. However, this did not correspond with increased postoperative opioid consumption, suggesting that anxiety may primarily amplify the subjective perception of pain without necessarily increasing the physiological demand for analgesia. This observation is consistent with prior research indicating that anxiety is a reliable predictor of postoperative pain intensity in cardiac surgery patients.[20,21]

Altogether, this study highlights the imperative for all professionals involved in perioperative care, including but not limited to anesthesiologists, to recognize and address the

Table 2
Univariable Linear Regression Analyses: Effect of Preoperative Anxiety on Postoperative In-hospital Opioid Consumption and VAS Pain Scores at Days 1, 2, and 5 at Rest and Movement

Dependent Variable	Unstandardized Coefficient		Standardized Coefficient β	95% CI β	t	p-Value
	β	SE				
Total opioids (mg)	7.36	4.85	0.11	−2.21 to 16.94	1.52	0.131
VAS score D1 (rest)	0.39	0.25	0.12	−0.11 to 0.89	1.54	0.125
VAS score D1 (movement)	0.49	0.29	0.13	−0.10 to 1.07	1.65	0.101
VAS score D2 (rest)	0.53	0.26	0.15	0.02 to 1.04	2.04	0.043*
VAS score D2 (movement)	0.69	0.30	0.17	0.10 to 1.28	2.30	0.023*
VAS score D5 (rest)	0.44	0.24	0.13	−0.04 to 0.93	1.82	0.071
VAS score D5 (movement)	0.89	0.34	0.19	0.22 to 1.56	2.63	0.009*

Abbreviations: D, day; VAS, visual analog scale.
* p < 0.05.

psychological dimensions of surgical care. The importance of multidisciplinarity and the systematic involvement of cardiac surgeons and cardiologists, for instance, is well illustrated in our own experience, as only 14.5% of our cardiac surgery patients benefited from a dedicated anesthesia consultation at least a week before their surgery. This low percentage is mainly explained by the urgent character of most cardiac interventions and the frequent transfer of patients to a tertiary specialized hospital for their procedure. With a little more time, some targeted interventions have already been suggested to help mitigate preoperative anxiety, such as preoperative psychological counseling, cognitive-behavioral therapy, relaxation techniques, and appropriate pharmacologic support.[22-24] In the end, proactive management of psychological factors would have the potential not only to enhance patient experience and modulate pain perception but also to contribute to the overall success of the surgical procedure.

Funding

This work was supported by the Belgian National Fund for Scientific Research (32739933, 2018−40000401, 2020).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Iuliana Marinela Lupu: Writing − original draft. **Cristina Bianca Robu:** Writing − original draft. **Mona Momeni:** Writing − review & editing, Supervision, Methodology, Investigation. **Céline Khalifa:** Writing − original draft, Project administration, Funding acquisition, Data curation, Conceptualization.

References

1 Zubrzycki M, Liebold A, Skrabal C, et al. Assessment and pathophysiology of pain in cardiac surgery. J Pain Res 2018;11:1599–611. https://doi.org/10.2147/JPR.S162067.
2 Huang AP, Sakata RK. Pain after sternotomy—review. Braz J Anesthesiol 2016;66:395–401. https://doi.org/10.1016/j.bjane.2014.09.013.
3 Dunn LK, Durieux ME, Fernández LG, et al. Influence of catastrophizing, anxiety, and depression on in-hospital opioid consumption, pain, and quality of recovery after adult spine surgery. J Neurosurg Spine 2018;28:119–26. https://doi.org/10.3171/2017.5.SPINE1734.
4 Ji W, Sang C, Zhang X, Zhu K, Bo L. Personality, preoperative anxiety, and postoperative outcomes: A review. Int J Environ Res Public Health 2022;19:12162. https://doi.org/10.3390/iejerph191912162.
5 Prado-Olivares J, Chover-Sierra E. Preoperatory anxiety in patients undergoing cardiac surgery. Diseases 2019;7:46. https://doi.org/10.3390/diseases7020046.
6 Cook C, Baxendale S. Preoperative predictors of postoperative satisfaction with surgery. Epilepsy Behav 2022;129:108612. https://doi.org/10.1016/j.yebeh.2022.108612.
7 Khalifa C, Lenoir C, Robert A, et al. Intra-operative electroencephalogram frontal alpha-band spectral analysis and postoperative delirium in cardiac surgery: A prospective cohort study. Eur J Anaesthesiol 2023;40:777–87. https://doi.org/10.1097/EJA.0000000000001895.
8 Khalifa C, Robert A, Cappe M, et al. Serum neurofilament light and postoperative delirium in cardiac surgery: A preplanned secondary analysis of a prospective observational study. Anesthesiology 2024;140:950–62. https://doi.org/10.1097/ALN.0000000000004922.
9 Tombaugh TN, McIntyre NJ. The Mini-Mental State Examination: A comprehensive review. J Am Geriatr Soc 1992;40:922–35. https://doi.org/10.1111/j.1532-5415.1992.tb01992.x.
10 Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. Acta Psychiatr Scand 1983;67:361–70. https://doi.org/10.1111/J.1600-0447.1983.tb09716.x.
11 Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193–213. https://doi.org/10.1016/0165-1781(89)90047-4.
12 Abate SM, Mantefardo B, Basu B. Global prevalence and determinants of preoperative anxiety among surgical patients: A systematic review and meta-analysis. Int J Surg Open 2020;25:6–16. https://doi.org/10.21203/rs.3.rs-28832/v1.
13 Bedaso A, Mekonnen N, Duko B. Prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low-income and middle-income countries: A systematic review and meta-analysis. BMJ Open 2022;12:e058187. https://doi.org/10.1136/bmjopen-2021-058187.
14 Hernández-Palazón J, Fuentez-García D, Falcón-Araña L, et al. Assessment of preoperative anxiety in cardiac surgery patients lacking a history of anxiety: Contributing factors and postoperative morbidity. J Cardiothorac Vasc Anesth 2018;32:236–44. https://doi.org/10.1053/j.JVCA.2017.04.044.
15 Mavridou P, Dimitriou V, Manataki A, Arnaoutoglou E, Papadopoulos G. Patient's anxiety and fear of anesthesia: effect of gender, age, education, and previous experience of anesthesia. A survey of 400 patients. J Anesth 2013;27:104–8. https://doi.org/10.1007/s00540-012-1460-0.
16 Eberhart L, Aust H, Schuster M, et al. Preoperative anxiety in adults—a cross-sectional study on specific fears and risk factors. BMC Psychiatry 2020;30:140. https://doi.org/10.1186/s12888-020-02552-w.
17 Fathi M, Alavi SM, Joudi M, et al. Preoperative anxiety in candidates for heart surgery. Iran J Psychiatry Behav Sci 2014;8:90–6.
18 Jarmoszewicz K, Nowicka-Sauer K, Zemla A, Beta S. Factors associated with high preoperative anxiety: results from cluster analysis. World J Surg 2020;44:2162–9. https://doi.org/10.1007/s00268-020-05453-x.
19 Butris N, Tang E, Pivetta B, et al. The prevalence and risk factors of sleep disturbances in surgical patients: A systematic review and meta-analysis. Sleep Med Rev 2023;69:101786. https://doi.org/10.1016/j.smrv.2023.101786.
20 Fernández-Castro M, Jiménez JM, Martín-Gil B, et al. The influence of preoperative anxiety on postoperative pain in patients undergoing cardiac surgery. Sci Rep 2022;12:16464. https://doi.org/10.1038/s41598-022-20870-9.
21 Kashif M, Hamid M, Raza A. Influence of preoperative anxiety level on postoperative pain after cardiac surgery. Cureus 2022;14:e22170. https://doi.org/10.7759/cureus.22170.
22 Wang R, Huang X, Wang Y, Akbari M. Non-pharmacologic approaches in preoperative anxiety, a comprehensive review. Front Public Health 2022;10:854673. https://doi.org/10.3389/fpubh.2022.854673.
23 Stamenkovic DM, Rancic NK, Latas MB, et al. Preoperative anxiety and implications on postoperative recovery: What can we do to change our history. Minerva Anestesiol 2018;84:1307–17. https://doi.org/10.23736/S0375-9393.18.12520-X.
24 Kisielewska W, Kosciólek M, Kowalczyk W, et al. Decreasing preoperative anxiety in patients with newly available multimodal approaches—a narrative review. J Clin Med 2025;14:2940. https://doi.org/10.3390/jcm14092940.