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Original Article

Effectiveness of the Self-report Pain Intensity Scale in Pain Control After Coronary Artery Bypass Surgery

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ABSTRACT

Background: Pain following cardiac surgery is common, and pain assessment is a precondition for adequate pain management. We designed this study to evaluate the effectiveness of pain control using the self-report pain intensity scale during the postoperative period after coronary artery bypass surgery in the cardiac ICU.

Methods: Of 160 patients scheduled for elective coronary revascularization, 154 patients were included in this prospective, double-blind clinical trial. The pain management program was performed on conscious patients for 48 hours. The study population was randomly divided into 2 groups. One group received analgesics as needed, based on conventional nurse-controlled analgesia (the NCA group; n=77), and the other group received analgesics based on the pain intensity score determined using the linear numerical rating scale (NRS group; n=77). In both groups, opioid and non-opioid analgesic consumption and satisfaction levels with pain relief were recorded.

Results: The use of the self-report pain intensity scale led to an increase in the number of recipients of analgesic drugs and a decrease in their opioid/analgesic consumption during a 48-hour period in the NRS group. Satisfaction levels with pain relief were higher in the NRS group than in the NCA group (maximum satisfaction =43 [55.8%] vs 9 [11.8%], respectively; *P*=0.0001).

Conclusions: The findings of this study showed the efficacy of the self-report pain intensity scale in controlling patients' pain, using adequate and appropriate analgesics, prescribing accurate amounts of medication based on patients' pain, and increasing patients' satisfaction with pain relief. ***(Iranian Heart Journal 2022; 23(1): 205-213)***

KEYWORDS: Pain measurement tool, Pain management, Cardiac surgery, Intensive care unit

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Postoperative pain is the most inefficiently managed symptom of cardiac surgery. [1] Up to 75% of patients report moderate to severe pain after cardiac surgery during their intensive care unit (ICU) stay, [2,3] which can be caused by intravascular cannulations, saphenous vein and internal mammary artery harvesting, sternotomy, sternal retraction, and chest tube insertion and removal after surgery. [4] Studies have shown that removing the chest tube produces the highest pain score. Indeed, endotracheal tube suctioning, coughing, and chest physiotherapy during ICU stay all have the highest mean pain intensity scores. [5] The stress response and enhanced sympathetic tone, [6–8] which can increase heart rate, myocardial work, myocardial oxygen consumption, and pulmonary vascular resistance are some of the detrimental effects of postoperative pain after cardiac surgery. Post-cardiac surgical pain can also negatively affect the respiratory system. [9–11]

Proper postoperative pain control in patients undergoing heart surgery may precipitate recovery, reduce stress, improve sleep quality, enhance satisfaction, reduce the duration of mechanical ventilation, decrease complications such as pneumonia and atelectasis, shorten the duration of hospital stay, and diminish costs. [12,13]

Acute pain management after surgery is done via different methods and various drugs. [14-17] Intravenous long-acting opioids such as morphine are the commonly used medications; nonetheless, paracetamol, dexmedetomidine, and gabapentin are gaining popularity in use. [5,18,19] In the treatment of postoperative pain, PRN medication or nurse-controlled analgesia is a common method in ICU patients, while many nurses believe that cardiac surgery is not very painful. [20] As a result, they often underestimate patients' pain and use inadequate analgesics. [21–23]

Studies have shown that 71% of patients experience pain after cardiac surgery. [20] An inaccurate estimation of pain might be the cause of insufficient analgesic administration. [22]

Pain assessment is a precondition for adequate pain management, and the self-reporting of pain is considered the gold standard. [24,25] A linear numerical rating scale was identified as the most reliable and valid self-report pain intensity scale for use in ICU patients by Chanques et al [26] in 2010. Since fewer than 50% of intensive care specialists assess pain, in the present study, we sought to evaluate the effectiveness of pain control with the self-report pain intensity scale, consisting of a numerical rating scale (NRS) and a verbal rating scale (VRS) compared with conventional nurse-controlled pain, to determine the level of patients' pain and satisfaction, respectively, during the postoperative period after coronary artery bypass grafting (CABG) in the cardiac ICU.

METHODS

This prospective, randomized, double-blinded clinical trial was approved by our institutional ethics committee and was performed on 160 consecutive patients, aged between 35 and 70 years, in the American Society of Anesthesiologists (ASA) Class II and Class III scheduled for elective CABG under general anesthesia in Rajaie Cardiovascular Medical and Research Center. After evaluation for eligibility, 6 patients were excluded because of their refusal to participate. Ultimately, 154 patients, who gave informed consent, were enrolled in the study after they received comprehensive explanations regarding the objectives of the study and assurances concerning the confidentiality of their information. The patients' records regarding age, sex, body mass index, ejection fraction, cardiopulmonary bypass time, surgery duration, history of hypertension, diabetes mellitus, addiction, and smoking were stored in our database. The preoperative exclusion

criteria were left ventricular ejection fraction below 35%, hearing or speech impediments, illiteracy, allergies to the studied drugs, previous history of open-heart surgery, addiction, chronic underlying diseases (eg, cancer, renal dysfunction, and liver dysfunction). The postoperative exclusion criteria included hemodynamic instability, the need for inotropic support or intra-aortic balloon pumps, bleeding, surgical re-exploration, and a lack of cooperation on the part of the patient to determine pain intensity. The medication of all the patients was continued up to the day of surgery. The study population was premedicated with lorazepam (1 mg) and intramuscular morphine (0.1 mg/kg) 1 hour before entering the operating room. Standard hemodynamic monitoring, consisting of 5-lead electrocardiography (ECG), pulse oximetry, and invasive arterial blood pressure, was initiated before the induction of anesthesia. The protocol of the anesthetic medications was the same in all the patients and was based on standard clinical practices. Anesthesia was induced with 0.2 mg/kg of etomidate, 0.2 mg/kg of cisatracurium, and 2.5 μg/kg of sufentanil. Anesthesia was maintained after the insertion of the central venous line via a continuous infusion of midazolam, atracurium, and sufentanil in both groups. The pain management program was performed on conscious patients with the aid of non-opioid or opioid analgesics prescribed by a specialist and was monitored by nurses for 48 hours. The patients were randomly divided into 2 groups according to computer-generated random numbers. Patients in the NCA group (n=77) received analgesics (intravenous injection or rectal suppositories) as needed (PRN) until discharge from the ICU. Subjects in the NRS group (n=77) were monitored for a pain score of 1 to 3 and received intravenous paracetamol, rectal diclofenac, or acetaminophen for pain scores of 4 to 6. Additionally, morphine, fentanyl, or meperidine was injected for scores of 7 to 10 (Fig. 1).

The collaborating nurses and patients in this project were educated through an instruction booklet titled “How to score pain after surgery?” and bedside discussion (only for the patients). The collaborating nurses were also instructed on the use of an NRS for the measurement of postoperative pain and a VRS for the determination of the patients’ satisfaction levels. With the aid of the NRS, which ranged from 0 (no pain) to 10 (severe pain), pain intensity was assessed every 6 hours after the patients regained consciousness (ie, when communication with the nurses was possible even before extubation) until discharge from the ICU. The consumption of morphine and other opioid and non-opioid analgesics was also documented during the ICU stay. Finally, on the day of discharge from the ICU, the patients’ satisfaction levels were assessed and recorded via the use of the VRS. The VRS is a 4-point scale, in which satisfaction can be rated as follows: 1) dissatisfaction due to severe pain, 2) minimum satisfaction due to moderate pain, 3) relative satisfaction due to mild pain, and 4) maximum satisfaction due to no pain. All the data were collected by the nurse in charge of each patient on a separate sheet until the patient was discharged from the ICU.

Statistical analysis was conducted using the SPSS software for Windows, version 22.0, (SPSS Inc, Chicago, IL, USA). Clinical data were expressed as the mean ± the standard deviation (SD). Differences were analyzed using the independent Student *t* test for the values of a scaling term and the Pearson χ^2 test for nominal values. For 2×2 tables, continuity corrections were used; and for expected numbers below 5 in the Pearson χ^2 test, the Fisher exact test was employed. A *P* value equal to or less than 0.05 was considered statistically significant.

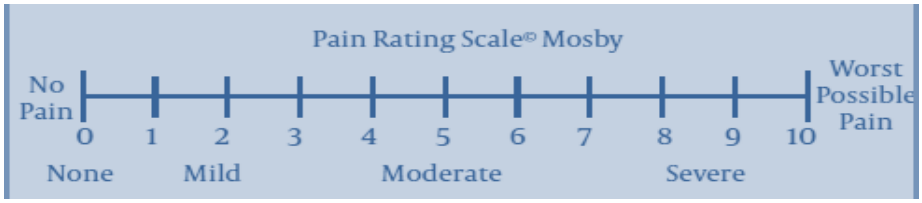

Figure 1. The image illustrates the numerical pain scale used in the current investigation.

RESULTS

Overall, 160 patients were accepted as study subjects, of whom 6 were excluded (3 patients in the NCA group and 3 patients in the NRS group) as they refused to participate, and 1 patient was excluded in the NCA group due to the need for intra-aortic balloon pumps and surgical re-exploration. Therefore, 76 and 77 patients were assessed in the NCA and NRS groups, respectively. The study protocol is presented in the flow diagram, depicted in Figure 2.

There were no statistically significant differences between the 2 groups with respect to sex, age, body mass index, left ventricular ejection fraction, cardiopulmonary bypass time, surgery duration, history of hypertension, diabetes mellitus, smoking, and addiction (Table 1).

There were no statistically significant differences between the 2 groups in terms of the number of coronary artery grafts (P=0.600) and the total chest tubes inserted and removed in the ICU (P=0.077) except for left pleural chest tubes (P=0.015). As regards the location of saphenous vein harvesting, there were statistically significant differences between the 2 groups (P=0.0001). Moreover, statistically significant differences were observed between the groups concerning intubation time in the ICU (P=0.001) (Table 2).

According to the findings, during the first 48 postoperative hours, there were no statistically significant differences between the number of recipients in the 2 groups for opioid and non-opioid analgesics (Table 3). The exceptions were morphine and paracetamol, the consumers of which were more frequent in the NRS group than in the NCA group, and the results of the χ^2 test showed a statistically significant difference between the 2 groups [48 (62.3) vs 32 (42.1); P=0.012 vs 47 (61.8) vs 59 (76.6); P=0.048]. On the other hand, in the NRS group, the average rate of morphine and meperidine consumption was lower (P=0.0001 and P=0.002, respectively), while the rate of paracetamol consumption was higher (P=0.050) than those in the NCA group. The results showed a statistically significant difference between the 2 groups vis-à-vis the dosage of these drugs (Table 3). Additionally, satisfaction levels with pain relief were higher in the NRS group in the NCA group (maximum satisfaction =43 [55.8%] vs 9 11.8%], respectively; P=0.0001]) (Table 4).

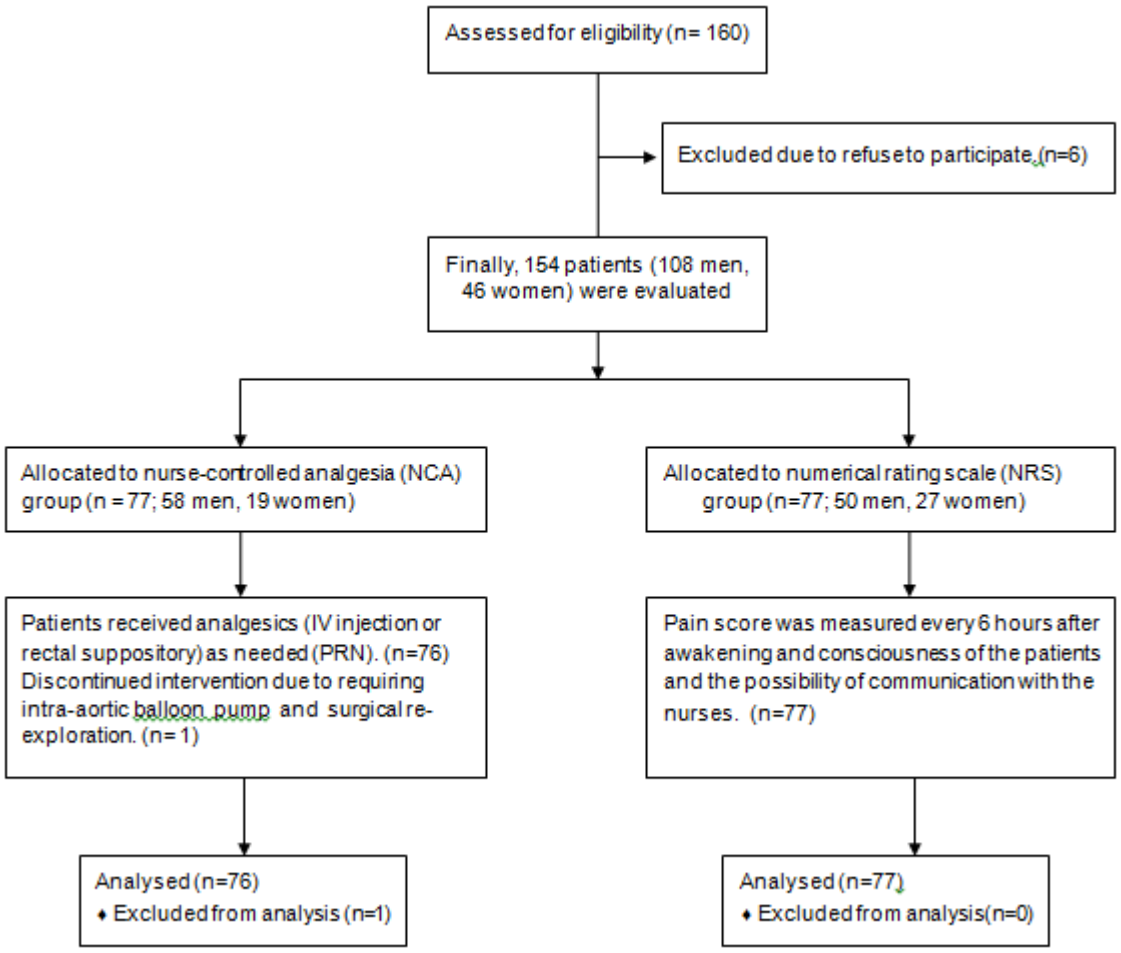

Figure 2. The flow diagram of the current trial is presented herein.

Table 1. Clinical characteristics of the studied patients

Characteristics	NCA Group (n=76)	NRS Group (n=77)	*P* value
Age, y	61.82 ± 9.11	62.25 ± 7.47	0.749
Sex, M/F	58/18 (76.3/23.7)	50/27 (64.9/35.1)	0.172
Height, cm	163 ± 9.07	165.19 ± 8.50	0.392
Weight, kg	75.62 ± 13.56	74.35 ± 14.16	0.573
Body mass index	28.41 ± 4.69	27.14 ± 4.56	0.093
Hypertension,%	45 (59.2)	55 (71.4)	0.156
Diabetes mellitus,%	29 (38.2)	33 (42.9)	0.669
Ejection fraction, %	43.66 ± 9.29	43.05 ± 7.39	0.656
Smoking,%	24 (31.6)	30 (39.0)	0.432
Addiction,%	15 (19.7)	14 (18.2	0.969
CPB time, min	76.54 ± 35.79	75.35 ± 27.33	0.818
Operation time, min	280.86 ± 50.81	272.14 ± 52.51	0.299

NCA, Nurse-controlled analgesia; NRS, Numerical rating scale; CPB, Cardiopulmonary bypass
Values are reported as the mean± SD, frequencies, or numbers (%).

Table 2. Intraoperative and postoperative variables in the 2 groups

	NCA Group	NRS Group	*P* value
Coronary Artery Grafts, No,%			0.600
1 graft	2 (2.6)	4 (5.2)	
2 grafts	15 (19.7)	13 (16.9)	
3 grafts	30 (39.5)	36 (46.8)	
4 grafts	23 (30.3)	22 (28.6)	
5 grafts	5 (6.6)	2 (2.6)	
6 grafts	1 (1.3)	0 (0.0)	
Saphenous Vein Harvesting Locations, %			0.0001
Lower limb (1 side)	26 (34.2)	24 (31.2)	
Below the knee (1 side)	34 (44.7)	18 (23.4)	
Below the knee (2 sides)	11 (14.5)	7 (9.1)	
Above the knee (1 side)	4 (5.3)	22 (28.6)	
Above the knee (1 side)	1 (1.3)	6 (7.8)	
ICU intubation time, h	9.55 ± 2.55	8.42 ± 1.42	0.001

Values are reported as the mean±SD, frequencies, or numbers (%).

Table 3. Number of recipients and the dose of analgesics within 48 hours after surgery

	NCA Group	NRS Group	*P* value
Morphine (NO,%)	32 (42.1)	48 (62.3)	0.012
Morphine (IV Dose, mg)	6.16 ± 2.24	4.36 ± 1.36	0.0001
Pethidine (NO,%)	11 (15.8)	15 (19.2)	0.549
Pethidine (IV Dose, mg)	52.27 ± 17.52	23.33 ± 11.16	0.002
Fentanyl (NO,%)	3 (3.9)	3 (3.9)	0.987
Fentanyl (IV Dose, µg)	180 ± 115	130 ± 29	0.547
Methadone (NO,%)	9 (13.2)	5 (6.5)	0.166
Methadone (IV Dose, mg)	5.67 ± 1.32	6.00 ± 2.24	0.729
Paracetamol (NO,%)	47 (61.8)	59 (76.6)	0.048
Paracetamol (IV Dose, gr)	1.23 ± 1.2	1.67 ± 1.02	0.050
Diclofenac (NO,%)	25 (35.5)	29 (37.7)	0.784
Diclofenac (Rectal Dose, mg)	114 ± 39.5	117 ± 384	0.762
Acetaminophen (NO,%)	7 (9.2)	3 (3.9)	0.184
Acetaminophen (Rectal Dose, mg)	507 ± 253	325 ± 0.00	0.264

Values are reported as the mean±SD, frequencies, or numbers (%).

Table 4. Patients' satisfaction on discharge from the ICU

	NCA Group	VRS Group	*P* value
Dissatisfaction	1 (1.3)	0 (0)	0.0001
Minimum	31 (40.8)	3 (3.9)	0.0001
Relative	35 (46.1)	31 (40.3)	0.0001
Maximum	9 (11.8)	43 (55.8)	0.0001

VRS, Verbal rating scale; Dissatisfaction = severe pain;
Minimum satisfaction = moderate pain; Relative satisfaction = mild pain;
Maximum Satisfaction = no pain; ICU, Intensive care unit

Values are reported as the mean±SD, frequencies, or numbers (%).

DISCUSSION

Postoperative pain is one of the major worries of patients and the most inadequately managed symptom among patients undergoing heart surgery. [1] Guidelines recommend that pain monitoring be routinely performed in all ICU patients with the aid of subjective (self-report) or objective (behavior observation) pain

assessment scales. [27] Studies have shown that 71% of patients experience pain after cardiac surgery, [20,28] and patients with an internal mammary artery graft have higher pain scores than those with saphenous vein grafts alone. [4,20] It has also been mentioned that removing a chest tube produces the highest pain score. [5] An incorrect estimation of pain might be the cause of inadequate and inappropriate analgesic administration. [22] Coventry et al [5] in 2006 reported no relationship between the administration of analgesia and the use of internal mammary artery grafts, saphenous vein grafts, and chest tube removal; nevertheless, there was a moderate correlation between time to extubation and morphine consumption. The results are similar to those in the present study. Yorke et al [20] in 2004 found that smaller amounts of morphine were used with PRN boluses of morphine in cardiac surgery patients who complained of moderate to severe pain. Contrary to that study, Topolovec et al [30] in 2010 showed that there was no difference in the type of medication and the amount of morphine used in each patient before and after pain assessment. Our study confirms the notion that the use of pain assessment scales not only has a positive effect on postoperative pain control and the appropriate and adequate use of analgesics but also is associated with higher satisfaction levels among patients. [12,26] In the treatment of postoperative acute pain, intravenous long-acting opioids such as morphine are the commonly used medications administered with different techniques. [3,31,32] The other analgesics are non-opioid analgesics such as paracetamol, which do not have the side effects of opioids. Whereas the efficacy of paracetamol in heart surgery was not proven by Eremenko et al [33] in 2008, the results of an investigation by McCarthy et al [34] in 2010 on 50 patients admitted to the ICU following cardiac surgery and analgesia with morphine and paracetamol showed acceptable efficacy. The findings of that study also demonstrated that most of the patients in both groups received morphine and paracetamol, which is in line with the results of the current research. Our findings showed that the number of morphine and paracetamol recipients in the NRS group was significantly higher than that in the NCA group (P=0.012 and P=0.048, respectively), which confirms the usefulness of pain assessment in recognizing patients in pain. Due to the effect of pain assessment on the choice of analgesic drug type and dosage, in the NRS group, morphine and meperidine consumption decreased significantly (P=0.0001 and P=0.002, respectively) and paracetamol consumption increased (P=0.050) by comparison with the NCA group. These results show that in the case of PRN medication (the nurse-controlled group), some patients do not receive analgesics despite the pain, and opioid analgesics are used incorrectly for moderate pain scales (4–6 scales), while they should be prescribed for severe pain (7–10 scales). Consequently, the rate of opioid analgesics used in the NCA group was higher than that in the NRS group. Be that as it may, these results were not obtained for the other analgesics used in this study.

CONCLUSIONS

Pain monitoring in ICU patients with the aid of subjective (self-report) or objective (behavior observation) pain assessment scales can assist in using adequate and appropriate analgesics, prescribing the accurate amount of medication based on patients' pain, and increasing patients' satisfaction levels with pain relief. Therefore, we recommend that pain monitoring be routinely performed in all ICU patients.

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