An investigation of the effect of patient-controlled analgesia on long-term quality of life after major surgery: A prospective cohort study

Ying-Hsuan Tai[a,b,c,d], Hsiang-Ling Wu[a,b], Shih-Pin Lin[a,b], Mei-Yung Tsou[a,b], Kuang-Yi Chang[a,b,*]

[a]Department of Anesthesiology, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; [b]School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC; [c]Department of Anesthesiology, Shuang Ho Hospital, Taipei Medical University, New Taipei City, Taiwan, ROC; [d]Department of Anesthesiology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, ROC

Abstract

Background: Chronic pain is a common postoperative complication in patients undergoing major surgery and may significantly affect their quality of life (QOL). Whether patient-controlled analgesia (PCA) can reduce the risk of chronic postsurgical pain and promote long-term QOL is still unclear.

Methods: In this prospective cohort study, we followed up patients undergoing major surgery, recorded changes in their post-operative QOL over time using the World Health Organization Quality of Life-BREF (WHOQOL-BREF) questionnaire and chronic pain events, evaluated the long-term effects of distinct PCA techniques (intravenous, epidural, or none) on their QOL and risk of chronic pain, and explored relevant predictors. The patients' QOL and chronic pain events were collected preoperatively, 3, 6, and 12 months after surgery. Generalized linear mixed models were used to control for individual heterogeneity and adjust for potential confounding factors.

Results: We included 328 patients undergoing major surgery from September 22, 2015, to December 31, 2016, in this study. Multivariate regression models showed that patients using intravenous PCA had a better QOL in physical health (adjusted coefficient 3.7, 95% CI, 0.5–8.0) compared with those receiving non-PCA treatments. Distinct PCA techniques did not significantly affect QOL in psychological, social relationship, or environmental domains of the WHOQOL-BREF scale or the risk of chronic postsurgical pain.

Conclusion: Patients using intravenous PCA had a better QOL in physical health over time after major surgery, which may have been due to factors other than pain-relieving effects.

Keywords: Chronic pain; Postoperative complication; Quality of life

1. INTRODUCTION

Chronic pain is a common complication in patients after major surgery and can be severe in about 2% to 10% of surgical patients.[1] Chronic postsurgical pain is difficult to manage and can significantly impact patients' quality of life (QOL) and pose significant economic and health-care burdens.[1] Considering that the intensity of acute surgical pain has been associated with the risk of developing persistent pain, early and effective treatments for acute surgical pain may prevent chronic postsurgical pain.[1] A recent meta-analysis included 49 studies with 1725 participants receiving patient-controlled analgesia (PCA) and 1687 participants allocated to control groups, and demonstrated that the patients receiving PCA had lower visual analog scale (VAS) pain intensity scores than those receiving non-PCA treatments.[2] In addition, a previous study revealed that PCA was beneficial in reducing the risk of chronic postsurgical pain in patients undergoing limb amputation.[3]

Health-related QOL after surgery has been reported to be strongly associated with overall survival after major upper abdominal surgery.[4] However, few studies have investigated the effect of different analgesic techniques for acute surgical pain on patients' QOL after major surgery, and most of these studies have focused on changes in the QOL in perioperative or short-term periods after surgery.[5] Since chronic postsurgical pain is commonly defined as pain lasting for at least 2 months after surgery,[6] it is of great importance to evaluate the effect of different pain control strategies on long-term QOL in surgical patients. In addition, most previous studies used the 36-Item Short Form Health Survey (SF-36) as the assessment tool for QOL; however, the SF-36 has been shown to measure health-related QOL rather than global QOL.[7] Psychosocial factors have been shown to have an important effect on the development of chronic pain,[8] which necessitates the use of evaluation instruments relevant to global QOL. We hypothesized that PCA may effectively reduce the incidence of chronic pain and promote long-term QOL in patients

*Address correspondence. Dr. Kuang-Yi Chang, Department of Anesthesiology, Taipei Veterans General Hospital, 201, Section 2, Shi-Pai Road, Taipei 112, Taiwan, ROC. E-mail address: kychang@vghtpe.gov.tw (K.-Y. Chang).

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after major surgery. Accordingly, we conducted this prospective cohort study to investigate the relationships between distinct PCA techniques and trends of changes in QOL over time or the risk of chronic pain after major surgery at a tertiary center and explore relevant influential factors. Global changes in QOL and the risk of chronic postsurgical pain in surgical patients were the primary and secondary outcomes, respectively.

2.METHODS

2.1. Setting and patient selection

Institutional Ethics Committee approval was granted by the Institutional Review Board of Taipei Veterans General Hospital, Taipei, Taiwan (IRB-TPEVGH No. 2015-04-003CC#1). This prospective cohort study was conducted at a tertiary center. All methods were performed in accordance with the relevant guidelines and regulations and written informed consent was obtained from each participant before study enrollment. The inclusion criteria were patients aged between 20 and 65 years undergoing elective major surgery (eg, thoracotomy, abdominal surgery, and mastectomy). The exclusion criteria were patients with a history of physical disability or substance abuse, severe anesthetic or operative complications, or postoperative admissions to intensive care units. From September 22, 2015, to December 31, 2016, 331 patients were recruited after meeting the selection criteria. Three patients were lost to follow-up within 1 year after surgery, and the remaining 328 patients were analyzed. The types of surgery and their frequencies are shown in Supplementary Appendix 1 (http://links.lww.com/JCMA/A44).

2.2. Acute pain management

All operations were performed under general anesthesia with neuromuscular block and inhalation agents as standard. At our center, patients undergoing major abdominal or thoracic surgery typically received intravenous PCA (IVPCA), patient-controlled epidural analgesia (PCEA), or as-needed analgesia at the discretion of the patients and anesthesiologists. IVPCA was typically administered via an ambulatory infusion pump (Gemstar Yellow, Hospira, IL) programmed to deliver morphine with a continuous infusion of 0.5 to 1.0 mg·hour^{-1} and boluses of 1 mg with a lockout time of 6 minutes. If PCEA was used for pain control, an epidural catheter was placed and its function was assessed with a test dose of local anesthetic preoperatively. Epidural analgesia was started before surgical incision with local anesthetic (bupivacaine 0.25% or 0.5%) and continued at a rate of 5 to 10 mL·hour^{-1} based on the patients' hemodynamics. PCA was typically continued for 48 to 72 hours after surgery and switched to oral acetaminophen or nonsteroidal anti-inflammatory drugs thereafter. The response of patients receiving IVPCA or PCEA was followed by specialty anesthesiologists on a daily basis, and if there were adverse effects (eg, nausea, itchiness, sedation) or inadequate pain control, the infusion rate or bolus dose of PCA was adjusted accordingly. Patients receiving as-needed analgesia were given intravenous or oral opioids (eg, morphine and meperidine) or nonsteroidal anti-inflammatory drugs postoperatively.

2.3. Evaluation of QOL

In this study, changes in global QOL after major surgery were assessed using the brief form of the World Health Organization Quality of Life questionnaire (WHOQOL-BREF). The WHOQOL-BREF instrument was developed for cross-cultural comparisons of QOL and is available in more than 40 language versions.[9] Compared with the SF-36 survey for health-related QOL, the WHOQOL-BREF scale measures global well-being, including physical health, psychological, social relationship, and environmental subscales.[7] For each participant, the WHOQOL-BREF scale was measured at four time points (preoperatively, 3, 6, and 12 months after surgery) during admissions, visits to the hospital's outpatient clinics, or by telephone call. All WHOQOL-BREF scale scores were recorded by trained high-dependency research assistants who were blinded to the PCA techniques and not involved in data analysis.

2.4. Acute and chronic pain assessment

For acute surgical pain, VAS pain scores were recorded on a scale of 0 to 10, with 10 being the maximum imaginable pain, by trained specialist nurses at 8-hourly intervals for 24 hours after surgery, and 12-hourly intervals for 4 days thereafter. The risk of chronic postsurgical pain was evaluated at 3, 6, and 12 months after surgery by a specialist anesthesiologist. The diagnosis of chronic postsurgical pain was based on the International Association for the Study of Pain (IASP) definition.[6] The baseline characteristics and risk factors for chronic pain were also collected, including demographics, preoperative pain, preadmission use of analgesics, diagnosis of depression, type of surgery, anesthetic and analgesic management.

2.5. Statistical analysis

Comparisons of patient characteristics among groups were performed using the chi-square test for categorical variables and either analysis of variance (ANOVA) or the Wilcoxon rank-sum test for continuous variables, as appropriate. Generalized linear mixed models with random intercept and compound symmetry covariance structure were used to control for individual heterogeneity and evaluate correlations between distinct PCA techniques and QOL scores or the risk of chronic pain. The covariates significantly associated with WHOQOL-BREF scores in four domains (ie, physical health, psychological, social relationship, and environment) or chronic pain in the univariate models were used as candidates for stepwise model selection processes in the multivariate analysis. The entry and exit criteria of significance level were set at 0.05 and 0.1, respectively, to select factors associated with WHOQOL-BREF score or the risk of chronic pain in the multivariate analysis. A two-sided significance level of 0.05 was used to define a statistically significant difference. Bonferroni correction of the significance criterion for multiple comparisons was applied where appropriate. All statistical analyses were conducted using Statistics Analysis System (SAS), version 9.4 (SAS Institute Inc., Cary, NC).

3. RESULTS

A total of 328 patients were included in this study, of whom 144 (43.9%) received IVPCA, 59 (18.0%) received PCEA, and 125 (38.1%) received non-PCA analgesia. Table 1 shows the patients' characteristics of these three groups. Compared with the PCEA and non-PCA groups, the IVPCA group was more likely to be male, have preoperative pain, and use analgesics before the admission. Table 2 shows the anesthetic and operative characteristics of the three groups. The patients receiving IVPCA had a longer anesthesia time and were more likely to have a perioperative blood transfusion, cancer surgery, and abdominal surgery than those receiving PCEA or non-PCA analgesia. In addition, the IVPCA group had slightly higher mean VAS pain scores on postoperative day 1 to 3 and a longer length of hospital stay after surgery.

3.1. Long-term changes in QOL after major surgery

Figure 1 shows the changes in scores of the four QOL subscales over time after surgery. The physical health domain scores decreased gradually after surgery but remained steady 6 months after surgery.

Table 1

Patient demographics

	IVPCA (N = 144)	PCEA (N = 59)	No PCA (N = 125)	*p*
Age, y	51.7 ± 9.0	53.5 ± 7.6	52.3 ± 7.4	0.349
Sex, male	84 (58.3%)	27 (45.8%)	30 (24.0%)	<0.001
ASA class ≥3	18 (12.5%)	5 (8.5%)	7 (5.6%)	0.167
BMI, kg·m^{-2}	24.2 ± 4.2	24.3 ± 4.4	23.7 ± 3.7	0.479
Marital status				0.289
Married	114 (79.2%)	51 (86.4%)	93 (74.4%)	
Divorced	8 (5.6%)	4 (6.8%)	7 (5.6%)	
Unmarried	22 (15.3%)	4 (6.8%)	25 (20.0%)	
Childrearing	110 (76.4%)	53 (89.8%)	94 (75.2%)	0.048
Education, college, or higher	70 (48.6%)	32 (54.2%)	66 (52.8%)	0.650
Comorbidities				
Diabetes	10 (6.9%)	3 (5.1%)	10 (8.0%)	0.769
Coronary artery disease	7 (4.9%)	1 (1.7%)	2 (1.6%)	0.240
Heart failure	8 (5.6%)	1 (1.7%)	1 (0.8%)	0.062
Chronic kidney disease	8 (5.6%)	2 (3.4%)	2 (1.6%)	0.225
Depression diagnosis	9 (6.3%)	3 (5.1%)	9 (7.2%)	0.857
Preoperative pain diagnosis	47 (32.6%)	9 (15.3%)	28 (22.4%)	0.021
Preadmission analgesics	30 (20.8%)	4 (6.8%)	7 (5.6%)	<0.001

Values are presented as mean ± SD or counts (percent). Continuous variables were analyzed with analysis of variance tests; categorical variables were analyzed with Pearson chi-square tests.
ASA = American Society of Anesthesiologists; BMI = body mass index; IVPCA = intravenous patient-controlled analgesia; PCA = patient-controlled analgesia; PCEA = patient-controlled epidural analgesia.

Table 2

Anesthetic and surgical characteristics

	IVPCA (N = 144)	PCEA (N = 59)	No PCA (N = 125)	*p*
Anesthesia time, min[a]	270 (210–390)	225 (165–285)	180 (150–240)	<0.001
Blood transfusion	38 (26.4%)	7 (11.9%)	8 (6.4%)	<0.001
Cancer surgery	123 (85.4%)	41 (69.5%)	95 (76.0%)	0.024
Cancer adjuvant therapy	68 (47.2%)	19 (32.2%)	73 (58.4%)	0.004
Surgical site				<0.001
Abdomen	108 (75.0%)	7 (11.9%)	24 (19.2%)	
Thorax	34 (23.6%)	52 (88.1%)	18 (14.4%)	
Others	2 (1.4%)	0 (0%)	104 (83.2%)	
POD1-3 mean VAS pain score	2.6 (2.0–3.0)	2.3 (2.0–2.8)	2.0 (2.0–2.9)	0.014
POD1-5 mean VAS pain score	2.3 (2.0–2.9)	2.1 (1.9–2.5)	2.0 (1.9–2.6)	0.053
Combined analgesics				
NSAIDs	32 (22.2%)	23 (39.0%)	26 (20.8%)	0.019
Acetaminophen	43 (29.9%)	12 (20.3%)	90 (72.0%)	<0.001
Steroids	39 (27.1%)	31 (52.5%)	43 (34.4%)	0.003
Postoperative hospital stay, d	8 (6–10)	6 (5–8)	2 (1–5)	<0.001

Values are presented as median (interquartile range) or counts (percent). Continuous variables were analyzed with Wilcoxon rank-sum tests; categorical variables were analyzed with Pearson chi-square tests.
IVPCA = intravenous patient-controlled analgesia; NSAIDs = nonsteroidal anti-inflammatory drugs; PCA = patient-controlled analgesia; PCEA = patient-controlled epidural analgesia; POD = postoperative day; VAS = visual analog scale.
[a]On base-2 logarithmic scale.

The psychological domain scores showed a similar pattern to the physical health scores. Of note, the social relationship domain scores significantly decreased 3 months after surgery but remained stable after 6 months. In contrast, there was no significant change in environmental domain scores during the study period.

3.2. PCA use and QOL changes in physical health

In the univariate analysis, distinct PCA techniques were not associated with changes in physical QOL (p = 0.182). The covariates associated with physical QOL scores were age, American Society of Anesthesiologists (ASA) class ≥3, body mass index, marital status, childbearing, diagnosis of depression, preoperative pain, cancer surgery, and postoperative hospital stay. After adjusting for these variables, PCA techniques were significantly associated with changes in physical QOL (p = 0.020; IVPCA vs non-PCA: 3.7, 95% CI, −0.5 to 8.0; PCEA vs non-PCA: −3.3, 95% CI, −8.6 to 2.0). Other independent predictors for physical QOL were ASA ≥3, body mass index, and length of postoperative hospital stay (Table 3).

3.3. PCA use and changes in QOL in the psychological domain

The univariate analysis showed that distinct PCA techniques were not associated with changes in psychological QOL (p = 0.365). The covariates significantly or borderline associated with psychological QOL scores were ASA class ≥3, body mass index, marital status, childbearing, diagnosis of depression, cancer surgery, and postoperative length of hospital stay. Multivariate models showed that distinct PCA techniques were not associated with changes in psychological QOL (p = 0.108). ASA class ≥3 was a significant risk factor for a decline in psychological QOL after major surgery (Table 3).

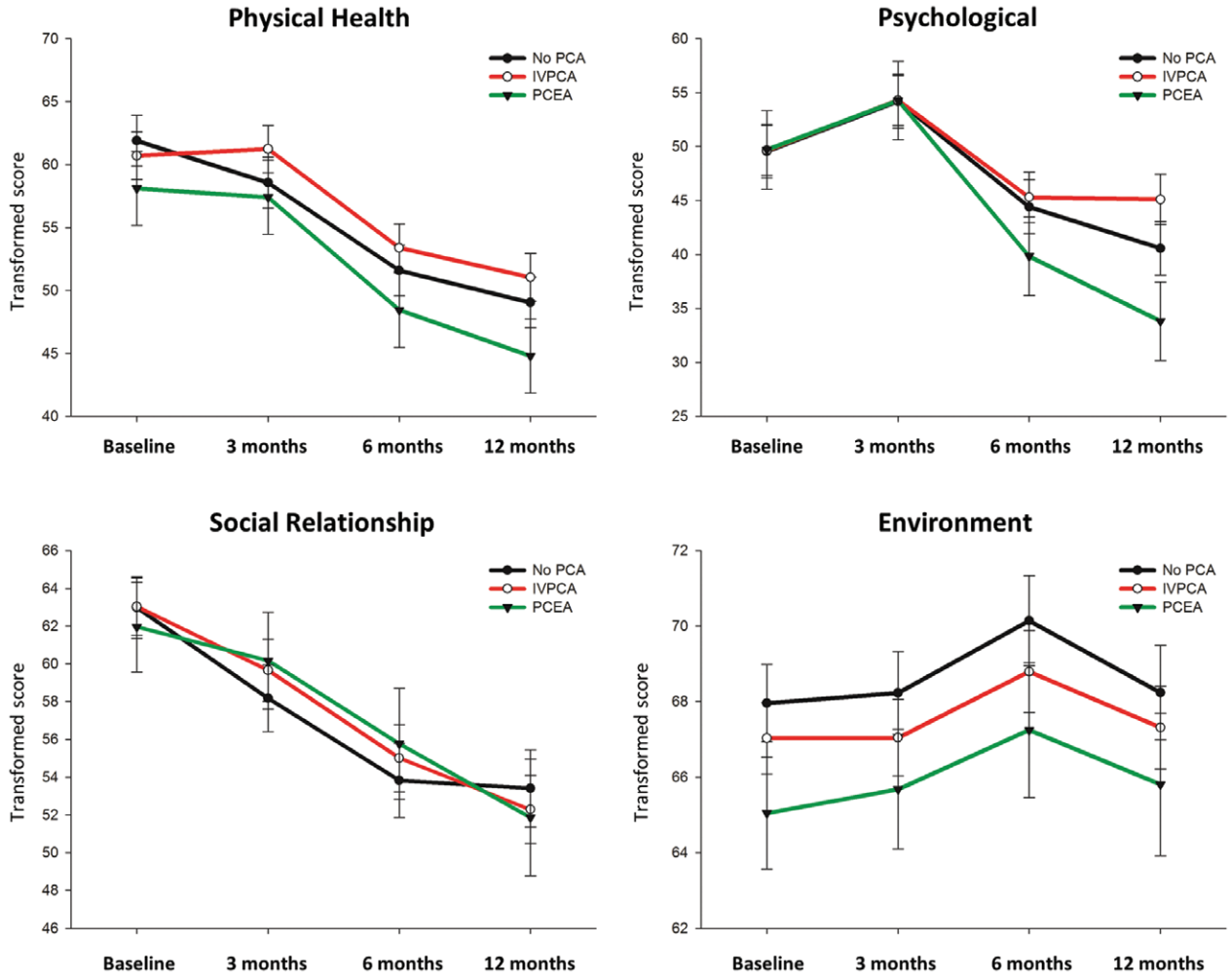


Fig. 1. Changes in scores of quality of life over time. IVPCA = intravenous patient-controlled analgesia; PCA = patient-controlled analgesia; PCEA = patient-controlled epidural analgesia.

3.4. PCA use and changes in QOL in the social relationship domain

The univariate analysis showed that distinct PCA techniques were not associated with changes in QOL in social relationships (p = 0.953). The covariates significantly or borderline associated with QOL scores in social relationships were age, ASA class ≥3, body mass index, marital status, education level, comorbidities (diabetes, heart failure, chronic kidney disease), diagnosis of depression, preoperative pain, surgical site, use of nonsteroidal anti-inflammatory drugs, mean VAS pain scores on postoperative day 1 to 3, cancer adjuvant therapy, and postoperative length of hospital stay. After adjusting for these covariates, distinct PCA techniques were not associated with changes in QOL in social relationships (p = 0.311). Independent predictors for changes in QOL in social relationships included age, marital status, body mass index, diagnosis of depression, use of nonsteroidal anti-inflammatory drugs, and surgical site (Table 3).

3.5. PCA use and changes in QOL in the environmental domain

Distinct PCA techniques were not associated with changes in QOL in the environmental domain in the univariate analysis (p = 0.149). The covariates significantly or borderline associated with environmental QOL scores were age, body mass index, marital status, education level, chronic kidney disease, diagnosis of depression, preoperative pain, use of preadmission analgesics and nonsteroidal anti-inflammatory drugs, and postoperative length of hospital stay. The multivariate models showed no association between PCA use and environmental QOL scores (p = 0.103). Independent prognostic factors for environmental QOL included body mass index, marital status, chronic kidney disease, diagnosis of depression, and use of nonsteroidal anti-inflammatory drugs (Table 3).

3.6. PCA use and risk of chronic postsurgical pain

Distinct PCA techniques were not associated with the risk of chronic pain in the univariate analysis (p = 0.126). The covariates significantly or borderline associated with chronic pain were ASA class ≥3, body mass index, education level, preoperative pain, perioperative blood transfusion, and postoperative length of hospital stay (Table 4). After adjusting for these covariates, PCA techniques were not associated with the risk of chronic pain (p = 0.115; IVPCA vs non-PCA: adjusted odds ratio [OR]: 0.97, 95% CI: 0.55–1.72; PCEA vs non-PCA: adjusted OR: 1.84, 95% CI: 0.94–3.61). Body mass index was the independent predictor for chronic pain (adjusted OR: 0.92, 95% CI: 0.86–0.98; p = 0.009) (Table 4).

Table 3

Predictors for quality of life in four domains by multivariate analysis

Physical health	Coefficient (95% CI)	*p*	Psychological	Coefficient (95% CI)	*p*
PCA		0.020	PCA		0.108
IVPCA vs nil	3.7 (–0.5 to 8.0)	0.087	IVPCA vs nil	3.8 (–1.5 to 9.0)	0.159
PCEA vs nil	–3.3 (–8.6 to 2.0)	0.224	PCEA vs nil	–2.5 (–9.0 to 3.9)	0.443
ASA ≥ 3	–7.6 (–13.9 to –1.2)	0.020	ASA ≥ 3	–8.5 (–16.2 to –0.7)	0.033
BMI	0.5 (0–0.9)	0.048	BMI	0.5 (–0.1 to 1.0)	0.094
Hospital stay	–0.3 (–0.6 to 0)	0.069			
Social relationship	**Coefficient (95% CI)**	*p*	**Environment**	**Coefficient (95% CI)**	*p*
PCA		0.311	PCA		0.103
IVPCA vs nil	–3.2 (–7.8 to 1.5)	0.180	IVPCA vs nil	–0.4 (–2.7 to 1.9)	0.703
PCEA vs nil	–0.5 (–6.2 to 5.2)	0.862	PCEA vs nil	–3.0 (–5.9 to –0.1)	0.040
Age	–0.4 (–0.6 to –0.2)	<0.001	BMI	0.3 (0–0.5)	0.032
Marital status		<0.001	Marital status		0.009
Married vs nonmarried	5.4 (0.9–9.8)	0.019	Married vs nonmarried	–0.4 (–3.4 to 2.6)	0.796
Divorced vs nonmarried	–6.5 (–14.0 to 0.9)	0.087	Divorced vs nonmarried	–6.8 (–11.7 to –1.9)	0.007
BMI	0.4 (0.1–0.8)	0.024	CKD	–5.4 (–10.7 to –0.1)	0.047
Depression	–8.6 (–14.6 to –2.7)	0.005	Depression	–6.8 (–10.8 to –2.9)	<0.001
NSAIDs	–5.7 (–9.2 to –2.2)	0.002	NSAIDs	–2.7 (–5.0 to –0.4)	0.020
Surgical site		0.010			
Others vs abdomen	–5.9 (–10.1 to –1.6)	0.007			
Thorax vs abdomen	–6.6 (–12.2 to –0.9)	0.023			

ASA = American Society of Anesthesiologists; BMI = body mass index; CKD = chronic kidney disease; IVPCA = intravenous patient-controlled analgesia; NSAIDs = nonsteroidal anti-inflammatory drugs; PCA = patient-controlled analgesia; PCEA = patient-controlled epidural analgesia.

Table 4

Univariate and multivariate analyses for chronic postsurgical pain

	Univariate		Multivariate	
	OR (95% CI)	*p*	OR (95% CI)	*p*
PCA		0.126		0.115
IVPCA vs nil	1.14 (0.68–1.90)	0.630	0.97 (0.55–1.72)	0.924
PCEA vs nil	1.89 (1.01–3.55)	0.048	1.84 (0.94–3.61)	0.076
ASA class ≥ 3	1.97 (0.94–4.12)	0.074	1.98 (0.88–4.46)	0.099
Body mass index	0.92 (0.87–0.98)	0.013	0.92 (0.86–0.98)	0.009
Education, college, or higher	0.63 (0.40–1.01)	0.055	0.74 (0.45–1.21)	0.223
Preoperative pain	1.76 (1.08–2.90)	0.025	1.44 (0.83–2.48)	0.192
Blood transfusion	1.70 (0.94–3.10)	0.081	1.41 (0.69–2.88)	0.346
Postoperative hospital stay	1.03 (1.00–1.06)	0.059	1.01 (0.98–1.05)	0.555

ASA = American Society of Anesthesiologists; IVPCA = intravenous patient-controlled analgesia; OR = odds ratio; PCA = patient-controlled analgesia; PCEA = patient-controlled epidural analgesia.

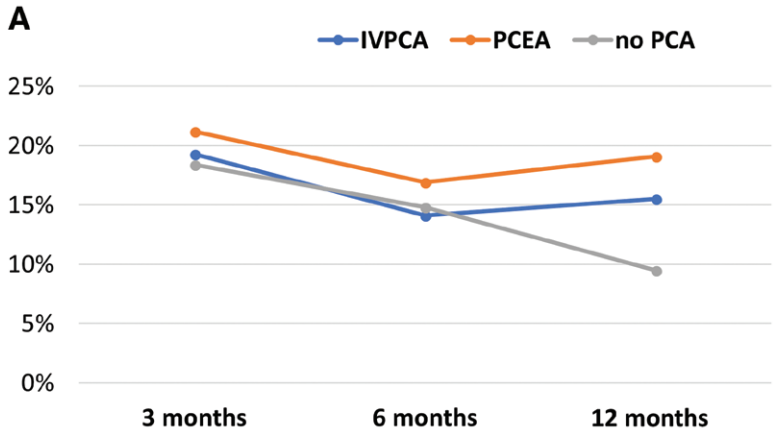
3.7. Risk of chronic postsurgical pain in distinct PCA groups and surgical types

Figure 2 shows the incidence of chronic postsurgical pain in our cohort. Of note, the patients using IVPCA or PCEA had a >15% risk of chronic postsurgical pain even 1 year after surgery (Fig. 2A). The patients who underwent upper abdominal surgery had the highest risk of persistent pain at 3 months after surgery; however, the risk decreased to <15% 1 year after surgery. The risk of post-thoracotomy chronic pain was about 20% during the whole 1-year follow-up period (Fig. 2B).

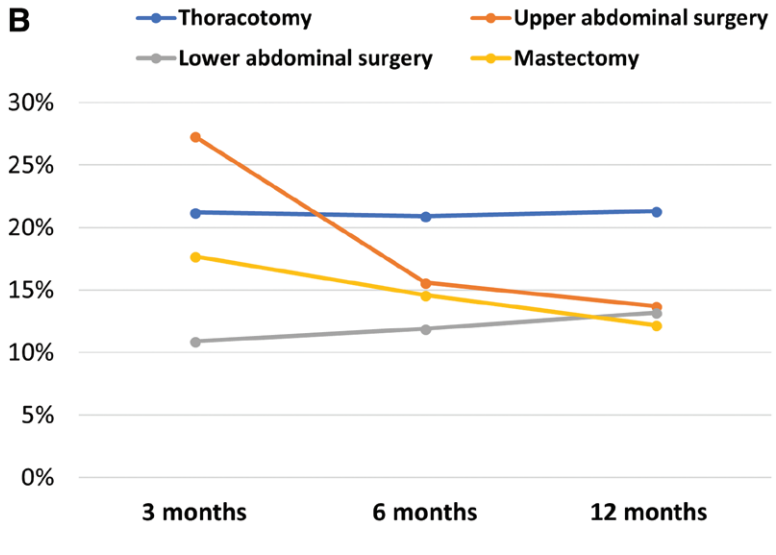
4. DISCUSSION

In this study, we found that the patients using IVPCA had better physical QOL scores compared with those using non-PCA analgesia. However, PCA use was not associated with other QOL subscales (ie, psychological, social relationships, or environmental) or the risk of developing chronic pain. Compared with previous investigations, our study provides new evidence to confirm the long-term benefits of PCA use in improving the physical health QOL of surgical patients. There are two main strengths to this study. First, we included patients receiving IVPCA, PCEA, and non-PCA analgesia to compare the effects of different pain techniques on long-term QOL and the risk of chronic postsurgical pain. Second, global QOL and chronic pain events were assessed within 1 year after surgery, which offered valuable information about changes in QOL and the risk of chronic pain in surgical patients.

Previous studies have shown that IVPCA or epidural analgesia can provide better pain control than on-demand opioid analgesia; however, few studies have assessed the effects of different analgesic techniques and the degree of analgesia on health-related QOL or quality of recovery as the primary outcome.[10] Katz and Cohen[11] reported that epidural analgesia reduced pain disability at 3 weeks but not 6 months after major gynecologic surgery by laparotomy. Similarly, Carli et al[12] reported that epidural analgesia provided superior quality of pain relief and improved out-of-bed mobilization, bowel function, intake of food, and health-related QOL in patients undergoing elective colonic resection at 3 and 6 weeks after surgery. In contrast, Zutshi et al[13] reported no significant difference between



	3 months	6 months	12 months
IVPCA	19.3%	14.1%	15.5%
PCEA	21.2%	16.9%	19.1%
no PCA	18.4%	14.8%	9.5%



	3 months	6 months	12 months
Thoracotomy	21.2%	20.9%	21.3%
Upper abdominal surgery	27.3%	15.6%	13.7%
Lower abdominal surgery	10.9%	11.9%	13.2%
Mastectomy	17.7%	14.6%	12.2%

Fig. 2. Risk of chronic postsurgical pain in distinct PCA groups and types of surgery. IVPCA = intravenous patient-controlled analgesia; PCA = patient-controlled analgesia; PCEA = patient-controlled epidural analgesia.

epidural analgesia and IVPCA in pain scores or short-term QOL in patients following laparotomy and intestinal resection. The discrepancies between these studies may be due to differences in the type of surgery, pain control regimens, and measurements of QOL.

A previous meta-analyses reported that epidural analgesia offered statistically better analgesia than both IVPCA and mixed systemic delivery of opioids for acute surgical pain for a variety of surgical procedures, but that the clinical superiority of epidural analgesia was uncertain.[10] Furthermore, the relationship between different analgesia techniques and the risk of chronic postsurgical pain is still unclear, and most previous studies have been conducted in patients undergoing thoracotomy. Epidural analgesia has been reported to reduce the risk and intensity of post-thoracotomy chronic pain in some studies[14,15] but not in others.[16] Our study showed no definite association between distinct PCA techniques and the risk of chronic postsurgical pain during the 1-year follow-up period. In addition to differences in patient characteristics and pain control regimens, our findings may be explained by the relatively low incidence of chronic pain in our cohort compared with previous studies.

Wide variations in the incidence of chronic postsurgical pain have been reported among different surgical procedures, ranging from 5% to 67% in thoracotomy, 11% to 57% in

mastectomy, and 12% to 18% in rectal amputation.[17] In our cohort, the risk of chronic postsurgical pain was 21.2% after thoracotomy, 27.3% after upper abdominal surgery, 10.9% after lower abdominal surgery, and 17.7% after mastectomy 3 months after surgery, which is generally lower compared with previous reports.[17] This may be due to differences in patient demographics and the common use of minimally invasive surgical techniques (eg, laparoscopic or robotic approaches) at our hospital, which has been shown to reduce the risk of chronic pain after hernia repair and cholecystectomy.[17]

Changes in health-related QOL after surgery have rarely been investigated. In this study, the patients undergoing major surgery had declines in the QOL in physical health, psychological, and social relationship domains, which is consistent with previous studies.[4,18–20] Changes in the QOL in surgical patients may be influenced by multiple factors, including preoperative cardiopulmonary reserve,[19] the type of surgery and extent of resection,[18,20,21] and postoperative adjuvant therapy.[20] Our analysis identified a number of independent predictors for different QOL subscales. In addition to the potential benefits of IVPCA in physical health QOL, postoperative length of hospital stay had a deleterious effect on physical health QOL. A recent meta-analysis demonstrated that enhanced recovery after surgery and fast track surgery protocols were effective in preventing healthcare-associated infections.[22] To enhance the QOL in physical health in surgical patients, anesthetic and surgical strategies aimed at shortening the length of hospital stay should be further developed.

Our results showed that a high body mass index had beneficial effects on QOL in four domains of the WHOQOL-BREF scale. Patients with upper abdominal malignancies are prone to malnutrition and cachexia which can manifest as preoperative weight loss, and this may impair both health-related QOL and survival.[4] In addition, our results suggested that a high body mass index was also a protective factor for chronic postsurgical pain, which is different from some studies. A high body mass index has been reported to be a risk factor for persistent postsurgical pain in patients following breast cancer resection.[23] However, patients with a body mass index ≤3rd quartile have been reported to have a higher risk of chronic pain after laparoscopic repair of inguinal hernia compared with their counterparts.[24] The effect of body mass index on chronic postsurgical pain may depend on the type of surgery, and further investigations are needed to elucidate this issue.

There are several limitations to this observational study. First, the patients were not randomized and clinical care was not standardized. The effects of unmeasured confounders could not be further controlled. Second, this study was conducted on the basis of the WHOQOL-BREF scale, and further studies are needed to assess the generalizability of our results to other QOL instruments.

In conclusion, we found that patients using IVPCA had a better QOL in physical health over time after major surgery, which may have been due to factors other than pain-relieving effects. Other domains, including psychology, social relationships, and environment, were not associated with the use of PCA. Further prospective investigations are necessary to elucidate the complex relationships between PCA use and long-term QOL after major surgery.

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APPENDIX 1. SUPPLEMENTARY DATA

Supplementary data related to this article can be found at http://links.lww.com/JCMA/A44.

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