ISSUES IN CLINICAL NURSING

Journal of Clinical Nursing

Using a patient-controlled analgesia multimedia intervention for improving analgesia quality

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Submitted for publication: 08 March 2006
Accepted for publication: 20 June 2006

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YEH M-L, YANG H-J, CHEN H-H & TSOU M-Y (2007) *Journal of Clinical Nursing* **16**, 2039–2046

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Aim. To evaluate the effects of analgesia quality provided by a patient-controlled analgesia multimedia intervention on the pain management of postsurgical patients in Taiwan.

Background. The concept of patient-controlled analgesia has become the mainstream pain treatment method because of its characteristic of instant self-administering medication. It is an important mission of nursing professionals to communicate effective and correct knowledge of patient-controlled analgesia on how to relieve pain and improve quality of care.

Design. A quasi-experiment research design was used for this study. Sixty subjects recruited from a medical teaching centre of Taiwan were assigned into either the experimental ($n = 30$) or control group ($n = 30$). The experimental group received the patient-controlled analgesia multimedia intervention. The control group only received one-on-one patient education of routine nursing guide and pain management with pamphlet. The pain cognition and American Pain Society patient outcome questionnaires were used as measures of effects for the interventions.

Results. The results showed the experimental group, compared with the control group, had significant improvement in pain cognition and analgesia quality. There is significant correlation between pain cognition and analgesia quality.

Conclusions. After intervening, the patients approved of the patient-controlled analgesia multimedia intervention and affirmed the value of early acquisition of such

doi: 10.1111/j.1365-2702.2006.01770.x

information to their postsurgical treatments and recoveries. The higher the pain cognition patients obtained, the better the analgesia quality patients had.
Relevance to clinical practice. Applying the patient-controlled analgesia multimedia intervention for surgical patients to improve pain cognition, the utility of patient-controlled analgesia, pain relief and patient satisfaction is recommended.

Key words: nurses, nursing, pain, patient-controlled analgesia

Introduction

Pain is a complex experience of unpleasant sensation and emotion. It is an alarm signal of body injury to the brain and can stimulate protective reactions of the body to prevent further injury. It is now well recognized that appropriate pain relief can shorten the disease recovery cycle, reduce the duration of hospital stay, lower the readmission rate and improve patient quality of life (Phillips 2000). A ten-year investigation held in the US showed that about half of 23 million postoperative patients did not receive satisfactory pain treatment (Agency for Health Care Policy and Research 1992). To enhance the quality of pain management, the American Pain Society (American Pain Society 1995) (APS) established the Quality Improvement Guidelines for the Treatment of Acute Pain and Cancer Pain in which the importance of instructing patients in the correct knowledge about pain is stressed. In Taiwan, 98% of patients who had received orthopaedic operations experienced postoperative pain. Although the pain intensity was at least moderate in most cases, the majority of these patients (90%) did not ask for sufficient pain relief (Chen *et al.* 1998).

Deep structural harm impulses may set the spinal cord in prolonged excitement, which requires a large amount of opiates to be suppressed. However, the use of low-dose anaesthetics before the onset of pain stimuli can prevent the establishment of over-excitation in the spinal cord, based on which the concept of pre-emptive analgesia is formed (Kissin 2000). Pre-emptive analgesia is proposed to conquer pain associated with certain medical conditions, such as postoperative pain caused by surgical incision (Farris & Fiedler 2001). For postoperative pain management, patient-controlled analgesia (PCA) targeted at patients with medium to severe pain has been developed to be a safe, effective and patient-oriented pain-relieving approach (Tye & Gell-Walker 2000), which customizes anaesthetic delivery according to the need of each patient. A PCA system typically contains a computer-programmed pump administering the prescribed drug after an administration route is chosen and a button on the PCA device manually pressed under a patient's decision to launch the injection of painkiller within a certain range of dosage (Barbara 2002). To accomplish individualized pain management, a healthcare team should regularly visit PCA patients to provide consultations and evaluation of anaesthetic outcomes with which the administration and dosage of drug can be appropriately adjusted (Sdrales & Miller 2001).

Promotion of pain care quality is an important goal of medical services. To ensure the quality of analgesia provided with PCA, the following issues should be addressed: (i) problems caused by un-relieved pain; (ii) perception that PCA cannot provide any pain free guarantee, but keeps the patients conscious and comfortable enough to engage in rehabilitation; (iii) pain index, helpful to set up a suitable pain cure goal for patients; (iv) safety time interval for the painkiller administration of PCA; (v) how to use PCA for pain control; (vi) treatment of side effects; and (vii) pain treatment after patients stop using PCA (Pasero 1996a,b,1998). Using an education project instructing patients, medical service providers, or even the entire healthcare system in concepts about pain, pain care and pain measurement can effectively promote the quality of pain management in patients undergoing medical treatments (Miller *et al.* 1999). After systematically reviewing the literature and expert opinions, (APS) American Pain Society (1995) has developed a set of quality improvement guidelines for the treatment of acute and cancer-related pain, covering issues in pain care quality such as definitions of pain levels, the influence of pain on a patient's mental-physical functions, patients' ideas about pain, pain assessment and recording and pain care coverage and appropriateness. In the present study we intended to create instruction material for patient education, which could effectively convey necessary information about PCA to patients, in the hope of enhancing the quality of analgesia during their medical treatments.

With the advance of modern information technology, computer-assisted instruction (CAI) combined with a multimedia videodisc system has been used for improving the training of clinical nursing professionals as well as patient education (Yeh *et al.* 2002,2005, Yeh & Chen 2005, Chen & Yeh 2006). Multimedia instruction is typically delivered via texts, figures, sounds, animations and video clips to strengthen users' learning effectiveness. The most significant characteristic of multimedia instruction is that it has no limits in either space or time; therefore, learners can directly access a

particular topic in the programme anytime and anyplace if a VCD device is available (Yeh & Chen 2002, Chen & Yeh 2005, Yang *et al.* 2006). A multimedia program providing multi-faceted nursing instruction could not only induce users' motives to learn, but also promoted their learning effectiveness (Yeh *et al.* 2005, Yeh & Chen 2005, Chen & Yeh 2006). Presently, when more healthcare settings in Taiwan and countries around the world have been tightening their personnel budgets, the use of CAI with multimedia videodisc system may reduce the personnel cost of medical and nursing education while patients' needs for learning self-care skills can be still be fulfilled. It is nursing personnel's responsibility to provide patients with effective and correct knowledge of PCA on how to relieve pain and improve quality of care. No study has been reported to address the efficacy of multimedia instruction program in teaching patients about PCA administration. Therefore, the purpose of this study was to evaluate the effects of a PCA multimedia intervention on the pain management of orthopaedic patients in terms of their pain cognition and analgesia quality.

Method

Design

A quasi-experimental research design was used. Subjects were not assigned randomly into either the experimental or control group. All subjects were allowed to discuss their analgesia with the pain nurse as usual. The control group received one-on-one patient education comprising routine nursing guide and pain management with pamphlets. Subjects who were willing to try the PCA multimedia intervention were assigned to the experimental group. The experimental group received PCA multimedia VCDs and printed booklets (Yeh *et al.* 2004) distributed by the authors. The major content of PCA multimedia videodisc with printed booklet included four main sections: introduction, conditions, nursing guild and FAQs about clinical conditions or situations related to pain. Each section was composed of word description, pictures, figures, films, sound, etc. The length of the entire programme was about 19·5 minutes of continuous play.

Sample

Subjects were recruited from a 4000-bed medical teaching hospital in Taipei, Taiwan. All subjects were scheduled for total knee replacement under general anaesthetic because of osteoarthritis and consent to use epidural PCA. Ethical approval was obtained from the ethics committee of the same hospital. Informed consent was also obtained from all subjects. Subjects were made aware that data collected by the authors in the study would remain confidential and the anonymity would be assured; they would be free to withdraw from the study at any time during the study. Pretest pain cognition, demographic characteristics and clinical characteristics were collected after admission. Both groups then received their nursing interventions before surgery at the ward. The quality of analgesia was evaluated once a day for three days after surgery. Post test pain cognition and PCA multimedia utility were assessed on day 4 after surgery.

Instrumentation

Subjects' demographic and clinical characteristics gathered in the present study included age, educational level, marital status, number of of-age children, primary caregiver, history of diagnosis and treatment of arthritis, other medical conditions, body mass index, previous anaesthetic history and history of prior analgesia. A pain cognition questionnaire of 15 true/false questions, designed according to the content of PCA multimedia intervention, was used to evaluate patients' cognition and understanding about pain. Each question correctly answered was scored one point. The higher the sum of scores, the better the knowledge a patient had about pain. The content validity index (CVI) and the Cronbach's α of this questionnaire were 0·89 and 0·91, respectively, in this study. A Chinese translation version of the American Pain Society Patient Outcome Questionnaire (APSPOQ) was used to evaluate the quality of analgesia in the following respects: mean pain score, impact of pain on body-mind functional status, attitudes and beliefs towards pain and overall quality of analgesia (APS) (American Pain Society 1995). The content validity of the translation version was evaluated by clinical experts with a CVI value and internal consistency reliability of 0·92 and 0·90, respectively. The utility of the multimedia program was evaluated by using a utility evaluation questionnaire (Yeh & Chen 2002). After a slight modification recommended by clinical experts, the content validity was evaluated with a CVI value and internal consistency reliability of 0·90 and 0·91, respectively.

Results

Homogeneity of the two groups

There were 30 subjects in each of the experimental and control groups. The mean ages for the experimental and control groups were 72 (SD 6) years and 71 (SD 7) years, respectively, not significantly different in statistics. As shown in Table 1, the comparison of subjects' characteristics between the two groups

Table 1 Subjects' characteristics in the experimental and control groups

Variables/items	Experiment (%)	Control (%)	χ^2/t	p-value
Educational level			0·29	0·86
Junior high	20 (67)	18 (60)		
Senior high	6 (20)	7 (23)		
Bachelor and higher	4 (13)	5 (17)		
Marital status			0·67	0·88
Married	25 (83)	25 (83)		
Not married	5 (17)	5 (17)		
Number of of-age children			1·35	0·97
≤One	3 (10)	4 (13)		
Two	5 (17)	3 (10)		
Three	7 (23)	9 (30)		
Four	4 (13)	5 (17)		
Five	8 (27)	6 (20)		
Six	3 (10)	4 (10)		
Primary caregiver			1·30	0·95
Family member	21 (72)	20 (67)		
Friend	2 (7)	3 (10)		
Others	6 (21)	7 (23)		
Diagnosis of arthritis with operation			0·74	0·69
Left side	13 (43)	12 (40)		
Right side	15 (50)	14 (47)		
Both sides	2 (7)	4 (13)		
Number of other diagnosis			0·75	0·86
None	5 (17)	7 (23)		
One	9 (30)	8 (27)		
Two	14 (47)	12 (40)		
Three	2 (6)	3 (10)		
Body mass index			0·30	0·86
Normal	2 (7)	2 (7)		
Slightly higher	10 (33)	12 (40)		
Too high	18 (60)	16 (53)		
Previous anaesthetic history			0·60	0·44
None	16 (53)	13 (43)		
Yes	14 (47)	17 (57)		
History of prior analgesia			0·22	0·89
None	21 (70)	20 (67)		
Yes	9 (30)	10 (33)		

Data is presented as number (%).

by using the chi-square or t-test indicated that the two groups were homogeneous. Namely, the experimental and control groups shared similarity in these characteristics.

Pain cognition of the two groups

At pretest, the mean score of pain cognition in the experimental group was 8·43 and that in the control group was 8·47. The post test mean scores in the experimental and control groups were 12·6 and 8·77, respectively. The independent t-test indicated that the difference between the two post-test mean scores was significant ($t = -7{\cdot}61$, $p < 0{\cdot}001$) while that between the two pretest mean scores was not significant. The results are presented in more detail in Table 2. The paired t-test was used to compare the pre and post test mean scores in each group and the results indicated that the change of mean score in the experimental group was significant ($t = 18{\cdot}10$, $p < 0{\cdot}001$) while that in the control group was not.

Analgesia quality of the two groups

The investigation with APSPOQ indicated that both groups received similar medical and nursing services from the medical team. Both groups administered regular analgesia, 0·0625% Marcaine Bupivacaine and Fentanyl Citrate 1 μg/cc, through PCA. The results of APSPOQ investigation are summarized in Table 3. Pain experienced by patients was assessed by using the visual analogue scale (VAS) (rating from 0 = no pain to 10 = extreme pain). Pain scores in the control group were significantly higher than those in the experimental group, indicating the experimental group demonstrated a better pain relieving effectiveness. The impact of pain on patients' body-mind functional status was evaluated by using a 10-point scale (rating from 0 = no disturbance at all to 10 = complete disturbance). Among seven physical and mental activities tested, the control patients' walking ability, sleep and rehabilitation activities were significantly more disturbed by pain, compared with subjects in the experimental group. Patients' attitudes and beliefs towards pain were evaluated by using a five-point scale (rating from 0 = strongly disagree to 5 = strongly agree). Of the seven items in this subscale, five were scored significantly higher in the control group than in the experimental group, indicating the control patients perceived poorer pain control. The overall effect of PCA was also shown to be significantly better in the experimental group ($t = -2{\cdot}74$, $p = 0{\cdot}008$). Furthermore, the experimental group expressed a higher willingness to use PCA again than did the control group with statistical significance ($t = -2{\cdot}05$, $p = 0{\cdot}04$).

With regard to PCA utility, after onset of pain, it took an average of six minutes before patients in the experimental group pressed the self-administration button, compared with 20 minutes in the control group. Five patients in the control group and none in the experimental group had never pushed the self-administration button during pain attack. Of the five control patients, three simply waited for the pain to pass and two did not know they were allowed to push the button.

Table 2 Post-test pain cognition in the two groups

Items	Experiment, Mean (SD)	Control, Mean (SD)	*t*-value	*p*-value
Pain is a subject feeling	0·97 (0·18)	0·87 (0·35)	−1·40	0·17
In VAS 10 indicates no pain at all	0·80 (0·41)	0·27 (0·45)	−4·81	0·00
Patients can use PCA if they can judge their pain level	1·00 (0·00)	0·35 (0·00)	2·11	0·03
When placing epidural tube, patients should remain a 'bending knee and back' position	0·87 (0·27)	0·27 (0·45)	−5·80	0·00
Each person has a different sensitivity to pain	0·93 (0·25)	0·90 (0·31)	−4·60	0·64
Severe pain after surgery would make breathing shallower and lead to complications	0·90 (0·31)	0·73 (0·45)	−1·68	0·09
Morphine is a commonly used medication in PCA	0·80 (0·41)	0·70 (0·47)	−0·89	0·38
Patients can use pain score to express their pain levels	0·60 (0·50)	0·50 (0·51)	−0·77	0·44
After pushing self-administration button on PCA device, patients would experience the analgesic effect immediately	0·90 (0·31)	0·30 (0·47)	−5·90	0·00
Nausea and vomiting are the side effects that sometimes occur with PCA	0·70 (0·46)	0·70 (0·46)	0·00	1·00
Correct use of analgesics will not cause drug addiction	0·43 (0·50)	0·30 (0·47)	−1·06	0·29
By using PCA, patients can expect no pain at all when engaging in any rehabilitating activities	0·90 (0·31)	0·47 (0·51)	−4·01	0·00
After stopping using PCA, patients cannot ask for analgesics when feeling pain	0·87 (0·35)	0·80 (0·41)	−0·68	0·49
PCA self-administration button should be pushed by patients themselves	1·0 (0·00)	0·97 (0·18)	−1·0	0·32
Patients can carry PCA pump to leave bed and do activities	0·93 (0·25)	0·37 (0·49)	−5·62	0·00

A pain cognition questionnaire of 15 true–false items, based on content provided in the programme, was used to evaluate patients' pain cognition. Each item answered correctly was scored one point. The higher the score, the better the knowledge.
VAS, visual analogue scale; PCA, patient-controlled analgesia.

Table 3 Quality of analgesia in the two groups under the PCA

Variables/items	Experiment, Mean (SD)	Control, Mean (SD)	*t*-value	*p*-value
Mean pain scores*				
The level of pain at the present	0·23 (0·43)	0·93 (1·05)	3·38	0·001
The worst pain in the past	4·50 (1·04)	5·50 (1·22)	3·40	0·001
The average pain in the past	3·26 (0·64)	4·13 (1·14)	3·63	0·001
Impact of pain†				
Walking ability	4·03 (0·10)	4·70 (0·84)	2·80	0·007
Sleep	1·50 (1·11)	2·23 (1·33)	2·32	0·024
Rehabilitating activities	4·50 (0·51)	4·97 (1·13)	2·06	0·043
Attitudes and beliefs towards pain‡				
Analgesia cannot control Pain	1·77 (0·59)	2·80 (1·21)	4·22	0·000
Analgesia can cause drug addiction	0·83 (0·38)	3·37 (0·83)	8·22	0·000
Enduring pain is easier than enduring side effects of analgesia	0·10 (0·31)	0·43 (0·63)	2·62	0·01
Good patients should avoid reporting pain	1·15 (0·25)	2·10 (0·30)	9·41	0·00
Pain indicates deterioration of health condition	0·90 (0·55)	1·27 (0·83)	2·02	0·04
Overall analgesia quality	5·73 (0·45)	5·3 (0·66)	−2·74	0·008
Willing to use PCA next time	0·97 (0·18)	0·80 (0·41)	−2·05	0·04

PCA, patient-controlled analgesia.
*Mean pain scores *t* was evaluated by using the 10-point visual analogue scale rating from 0 = no pain at all to 10 = extreme pain.
†Impact of pain on body-mind functional status was evaluated on a 10-point scale from 0 = no disturbance to 10 = complete disturbance.
‡Attitudes and beliefs towards pain was evaluated on a 5-point scale from 0 = strongly disagree to 4 = strongly agree.

Certain proportions of patients in both groups had never asked to change their pain treatments. The reasons could be summarized as follows: (i) the pain relieving was effective, with 15 (71%) in the experimental group and four (18%) in the control group; (ii) fear of being addicted to painkillers, with none in the experimental group and two (14%) in the

control group; (iii) fear of obtaining side effects, with one (5%) in the experimental group and three (3%) in the control group; (iv) fear of causing harm to their health because of the overuse of painkillers, with three (14%) in the experimental group and three (13%) in the control group; (v) not knowing the use of more painkiller was permitted, with none in the experimental group and three (13%) in the control group. The results described above indicated that, although equipped with PCA, the control patients tended to be more conservative and hesitated to use PCA, compared with patients in the experimental group.

Correlation between pain cognition and analgesia quality

Pearson's correlation test was performed to investigate the correlation between pain cognition and analgesia quality. The results indicated that post-test pain cognition was significantly correlated with sleeping disturbance ($r = -0{\cdot}44$, $p < 0{\cdot}000$), easily becoming addicted to painkillers ($r = -0{\cdot}66$, $p < 0{\cdot}000$) and overall effect ($r = 0{\cdot}35$, $p < 0{\cdot}007$).

Utility of the PCA multimedia intervention

The utility of the PCA multimedia videodisc with printed booklet was evaluated by using an 11-item questionnaire. Each question was scored on a six-point scale and thereby the total score was 66. The mean scores for the utility of videodisc program and booklet were 5·17 and 5·46, respectively. The mean of summed score of all eleven items was 58·67 (SD 4·02; range 52–65). The mean of summed score of six items for the videodisc program was 32·77 (SD 2·76; range 28–36) and that of the rest five items for the booklet was 25·97 (SD 2·24; range 23–29).

Discussion

Subjects in the experimental and control groups were similar in age and disease conditions. In addition, both groups had comparable levels of pain cognition at pretest. The PCA multimedia intervention improved pain cognition of patients in the experimental group, who more frequently scored on questions 2, 3, 4, 9, 12 and 15 in the pain cognition questionnaire than did the control subjects at post test. This suggests that, after receiving the PCA multimedia intervention, the experimental group had corrected some of their misunderstanding about pain. It was clear that the combined use of the multimedia videodisc with printed booklet was an effective means to provide patients with better understanding and more confidence in using PCA. This is in agreement with the conclusion of other studies (Done & Lee 1998, Cassady *et al.* 1999) that multimedia is a beneficial and worthwhile tool for delivering nursing education programmes. Nevertheless, it is important to note that question 11, on concern of painkiller addiction, was scored relatively low, reflecting that, although being allowed to use PCA, most subjects were still worried about addictive problems. This is in agreement with the study of Fang *et al.* (2000). As a result, additional instruction stressing the safety of PCA might be required to dismiss and relieve patients' fears of drug addiction.

The quality of analgesia in the experimental group was superior to that in the control group with respect to pain score, impact of pain, satisfaction of pain treatment and willingness to use PCA next time. This is also consistent with findings in other studies (Grant *et al.* 1999, Miller *et al.* 1999). Both groups had low-scoring items over the impact of pain on mood and social relationship with other people. According to Gordon *et al.* (2002), each of them might be compounded by several psychological issues in patients and thus could be hardly measured by using single questions. Overall, the control group was more significantly influenced by pain in walking ability, sleep and rehabilitating activities such as coughing and deep breathing, compared with the experimental group. This may be attributed to the relatively high levels of pain in the control group during the first three days after surgery. With regard to pain cognition, more than half of patients in each of the two groups thought at pretest that even correct usage of painkillers could increase the risk of drug addiction. At post test, the experimental group expressed less worry about addictive problems, indicating that these subjects had learned correct knowledge in this issue through the PCA multimedia intervention. In contrast, the control patients' strong agreement with the ideas; 'analgesia can cause drug addiction' and 'analgesia cannot control pain,' suggested that they might not carry out effective learning through the one-on-one patient education with pamphlet. The patients in the experimental group perceived the overall analgesic effect was rather satisfactory, compared with the control patients. This is in agreement with the study of Knoerl *et al.* (1999). With regard to the administration of PCA, the time period for which the control subjects waited the pain to pass before pushing the self-administration button was three-fold longer than that taken in the experimental group. In addition, no subjects in the experimental group had never pushed the self-administration button, compared with five in the control group. Possible explanation for their failure to launch PCA was either having no knowledge of what the self-administration button was used for or being hesitating to apply analgesics.

After analysis, we found that the post test pain cognition of patients was negatively correlated with 'sleep disturbance', but positively with 'easy to become addicted to analgesics' and the overall analgesic effect. It can, therefore, be inferred that the pain cognition of patients who used PCA after surgery would be positively correlated with analgesia quality. In other words, the better the pain cognition was, the higher the analgesia quality could be reached. In patients having higher scores of pain cognition, the impact of pain on their body-mind functions was found to be less significant. We ascribed this analgesia-improving effect to effective learning through the PCA multimedia intervention, which could effectively provide patients with knowledge on how to use PCA appropriately and help them more confidently consult the pain care team about their current pain treatments, thereby resulting in better treatment effectiveness and lessening the impact of pain on their body-mind functions. By enhancing patients' pain cognition, those incorrect concepts keeping patients from administering PCA properly can be greatly diminished, in turn leading to better analgesia quality and higher pain care satisfaction (Knoerl *et al.* 1999). Therefore, it is secure to describe that our PCA multimedia intervention was effective in enhancing patients' pain cognition and consequently improved the quality of analgesia.

Finally, the experimental group thought that the PCA multimedia intervention was very useful in improving learning effectiveness and enhancing their cognition. This is similar to our previous studies (Yeh & Chen 2002,2005, Yeh *et al.* 2005, Chen & Yeh 2006). All of them wished they could have used the PCA multimedia program to learn the lessons anytime before surgery. The majority of experimental group indicated that the most useful topic in the videodisc program was the 'nursing guide'. This might reveal the facts that patient education was insufficient because of the reduction of nursing workforce and that acquisition of necessary instruction could be beneficial to their pain treatments and health recoveries. However, more research effort is required to address such an issue. The majority of experimental subjects played the PCA multimedia program with VCD players, indicating that this kind of device has been quite prevalent. Most subjects also recommended that hospitals could use this VCD multimedia program as patient education material to help patients using PCA.

Conclusion and recommendations

Subjects in the experimental group valued the PCA multimedia intervention in providing necessary instruction helpful for their postsurgical treatments and recoveries and recommended a wider application of such multimedia-based instruction in hospitals for patients in need. In the present study, the PCA multimedia intervention could enhance patients' pain cognition and the quality of analgesia. The higher pain cognition, the better the analgesia quality. The experimental group approved of the PCA multimedia intervention and believed in the value and usefulness of information it provided in their postoperative pain treatments and recoveries. We recommend that hospitals could incorporate the PCA multimedia intervention into their educational plans for patients about to receive PCA to enrich their knowledge of PCA and PCA administration in hopes of improving patients' analgesia quality after operation. However, we suggest that further research is required to support the preliminary results described in the present study, especially randomized studies and those incorporating patients receiving other surgical procedures. Finally, since most patients were concerned about drug addiction, it would be beneficial to provide patients with additional education and counselling to dismiss such deep-rooted misunderstanding and unnecessary fear of painkiller use.

Contributions

Study design: HJY, MLY, HHC; data collection and analysis: HJY, MLY, MYT and manuscript preparation: MLY, HHC, HJY.

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