Journal of Advances in Medical and Pharmaceutical Sciences
7(2): 1-9, 2016, Article no.JAMPS.25018
ISSN: 2394-1111

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The Role of Intraoperative Pain Assessment Tool in Improving the Management of Postoperative Pain

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Authors' contributions

Authors TWA and SK conceived the study with inputs from author ADBB for the design of the experiments. Recruitment of patients and counseling were carried out by authors SK and YWY. Data collection was carried out by authors TWA, SK and YWY, supervised by author ADBB. Authors TWA and SK led the data analysis with inputs from authors PPB and ADBB. The first draft of the paper was written by authors TWA and SK, and then authors PPB, YWY and ADBB contributed to revising and reviewing the paper. All authors read and approved of the final draft before submission.

Article Information

DOI: 10.9734/JAMPS/2016/25018
Editor(s):
(1) Erich Cosmi, Department of Woman and Child Heath, University of Padua, Italy.
Reviewers:
(1) M. Helmi, Tarumanagara University, Jakarta, Indonesia.
(2) Sara Bernardi, University of L'Aquila, Italy.
Complete Peer review History: http://sciencedomain.org/review-history/13824

Original Research Article

Received 13th February 2016
Accepted 12th March 2016
Published 24th March 2016

ABSTRACT

Background: Several studies have proven that despite the availability of quite a number of novel pain management techniques and medications, optimal perioperative pain control still remains a great challenge. Therefore, this suggests that no effort should be spared towards finding the right antidote to address the nagging challenge of inadequate perioperative pain management. The purpose of this study was to evaluate the effects of perioperative pain assessment with standardised pain assessment tools, as well as the role of preventive analgesia on postoperative pain outcomes.

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Methods: This study was carried out at the Tamale Teaching Hospital, Tamale, Ghana, West Africa. To achieve the objective of this study, 60 participants were recruited. They were randomly selected into two groups of 30 respondents for each group. Members of the study group (A) were assessed pre-operatively with a Numerical Pain Rating scale before they were given preventive analgesia and afterwards were then re-assessed with the same scale. Members of the study group were also assessed periodically during surgery with an Anaesthetized Patient Pain Scale and interventional pain therapy administered depending on their pain scores after each assessment. Respondents in the control group (B) were also assessed pre-operatively with the Numerical Pain Rating Scale, but afterwards they received the routine anaesthesia care as standard practice of the institution. Both groups had their immediate postoperative pain intensity levels assessed within the postoperative period of 1-12 hours with a Numerical Pain Rating Scale.

Results: Group A had a mean postoperative pain score of 4.57 which was lower, compared to a mean postoperative pain score of 6.47 for group B and the P-value for the comparison of the immediate postoperative pain scores of the two groups was less than 0.001.

Conclusions: The results of this study have adequately demonstrated that the use of standard pain rating tools for perioperative pain assessment, as well as implementing the concept of preventive analgesia, will contribute towards enhancing perioperative pain control and minimising postoperative complications related to pain.

Keywords: Pain management; preventive analgesia; postoperative pain; pain assessment.

ABBREVIATIONS

APPS : Anaesthetised Patient Pain Scale;
NPRS : Numerical Pain Rating Scale
ECG : Electrocardiogram;
SPSS : Statistical Package for the Social Sciences;
ORIF : (Open Reduction and Internal Fixation);
NSAID: (Non-Steroidal Anti-inflammatory Drug);
PCA : Patient-Controlled Analgesia (PCA).

1. BACKGROUND

Effective postoperative pain management is an essential aspect of the care of the surgical patients. Inadequate pain management, apart from being viewed as inhumane and insensitive to patients, can lead to increased rates of morbidity and mortality. There is empirical evidence to show that surgical trauma depresses the immune system and the extent of the depression is directly proportional to the degree of the surgical invasiveness. Hence, optimal analgesia can help avert the deleterious effects of surgical trauma. Some previous studies have suggested that afferent neuraxial blockade with local anaesthetics is the most effective analgesic technique [1].

Provision of effective control of postoperative pain following certain surgical procedures can be quite a daunting task. Previous studies have revealed that over 50% of patients undergoing surgery report postoperative pain as a major concern. Uncontrolled pain can cause myocardial ischemia and infarctions, pulmonary infections, paralytic ileus, urine retention, thrombo-embolisms, impaired immunity, as well as anxiety. Furthermore, inadequate pain management may lead to patient dissatisfaction, impaired patient rehabilitation, and a prolonged stay in the hospital [2]. The negative effect of postoperative pain on rehabilitation is of particular concern for patients undergoing joint replacement. Functional recovery and return of normal muscle activity is based on the ability of these patients to comply with rehabilitation. The drawbacks of inadequate rehabilitation are especially cumbersome in hip and knee surgeries, since faster ambulation leads to early discharge from the hospital. Furthermore, studies have shown that recovery from knee arthroplasty is prolonged for up to 50 days after surgery, maximum pain control is especially necessary for knee arthroplasty patients to allow recovery of range of motion and muscle strength for mobilization [3].

According to Alfonso and Reis [4], adequate use of sedative-hypnotic medications, as well as pain management medications perioperatively, are an integral part of anaesthesia that guarantees patients' safety and comfort. According to Jefferies [5], anesthesia prevents a patient from feeling the pains associated with the operation or being aware of events during the operation, but

may not prevent pain patterns from being centralised in the brain intra-operatively. This study added that intra-operative pain seems to have a correlation with long-term post-amputation (phantom) pain and that preventing the painful nerve impulses from getting to the brain may actually reduce the possibility of long-term post-amputation pain.

It is estimated that more than forty-five million surgical procedures are carried out in the USA yearly. Out of this number, about 10-50% individuals will have their acute postoperative pain develop into persistent postoperative pain and about 10% of these patients will have severe pain. It is opined that effective and timely pain management will help prevent pain-related complications and reduce pain expenditures [6].

A report by the Johns Hopkins University, USA [7] indicated that treatment of chronic pain costs the American population about US$635 billion annually. This figure was arrived at by assessing the incremental cost of healthcare, resulting from pain and the indirect cost of pain on lower productivity.

Considering the overwhelming negative impact that inadequate perioperative pain management has on affected individuals and whole nations as evidently and adequately exhibited above, it was worth researching further, using pain assessment tools and the concept of preventive analgesia, aimed at optimising perioperative pain management and minimising pain related complications, in order to enhance patients' postoperative pain outcomes.

1.1 Problem Statement

Several studies have highlighted the insufficient provision of pain relief for older in- patients. Although a number of validated measures aimed at promoting effective pain management are in existence, pain remains poorly assessed in some cases and, particularly, in the cognitively impaired. Without adequate and correct pain assessment, patients are more likely to receive inadequate or inappropriate analgesia, both of which can pose deleterious pain outcome [8]. The majority of medications and techniques that are used for analgesia in younger patients are equally suitable for older patients. However, dosages may have to be adjusted to avoid the side-effects that are associated with age-related changes in drug pharmacokinetics and pharmacodynamics, co-morbidity, frailty and compromise in cognition [9].

Surgical stress/pain produces a complex response pattern with an upsurge in catabolic hormones and reduction in anabolic hormones leading to an alteration in the normal balance (homeostasis) of protein and carbohydrate, as well as an increase in metabolism. Release of stress hormones such as cortisol and catecholamine are important determinants of this surgical stress response [10]. Therefore, interrupting the transmission of pain impulses from the injured area to the brain and preventing the sympathetic response with anaesthetic and analgesic agents, dampens this response patterns and re-establishes normal metabolic activity with improved post-surgical stress recovery [11].

Despite the known insults that surgery leads to severe post-operative pain, much has not been done about preventive analgesia and intraoperative pain assessment and management to help reduce post-operative pain. The main objective of this study was to evaluate the effects of preventive analgesia and perioperative pain assessment on patients' postoperative pain outcome.

1.2 Specific Objectives

The specific objectives of the study were to assess the pain management practices among anaesthesia providers; to evaluate the impact of using pain assessment tools on perioperative pain management; to assess patients pain concerns in the immediate postoperative period; to find out the most commonly used analgesics among anaesthetists for perioperative pain management; to assess the effect of preoperative analgesia on patients' postoperative pain intensity ratings.

2. MATERIALS AND METHODS

2.1 Numerical Pain Rating Scale

Patients' preoperative and postoperative pain intensities were scored using a Numerical Pain Rating Scale. The pain scores on this scale ranged from 0-10, with 0 meaning no pain and 10 indicating the most severe possible pain [12]. With this scale, patients were asked to score their own pain, based on how they felt about their pain intensities.

2.2 Anaesthetized Patient Pain Scale

An Anaesthetised Patient Pain Scale (APPS) designed using certain physiological and behavioural responses to pain that was used by Kampo et al. [13] in previous studies was adopted and slightly modified for the purpose of this study. This scale was used during the intraoperative period. The physiological and behavioural responses that were measured using this scale were blood pressure, heart rate, respiratory rate, facial expression, body movement and muscle tension. Each parameter was scored on the scale of 1-3. The total scores of the six parameters enumerated above were determined during each period of pain assessment. The total scores ranged from 6-18, where 6-9 was interpreted as no to mild pain, 10-14 as moderate to severe pain and 15-18 as severe pain.

2.3 Measurement

Patients' pain intensities were measured both preoperatively and postoperatively with a numerical pain rating scale and intraoperatively with an anaesthetised patient pain scale.

2.4 Ethical Consideration

Institutional authorization was obtained from the department of research and developments of the Tamale Teaching Hospital (TT/R&D/SR/13/98). Permission to undertake the study at the facility was sought and was granted by the hospital management and the head of the orthopaedic unit. All patients recruited for this study offered informed consent.

2.5 Data Collection Techniques

Preoperatively, all patients belonging to both the study and the control groups had their individual pain intensities scored with a numerical pain rating scale. The numerical pain rating scale is a typical 10-point scale in which the end points signify the extremes of pain. It is a line with the numbers 0 to 10 written at equal intervals where 0 indicates no pain, 5 indicate moderate pain, and 10 indicate the worst imaginable pain. For the purpose of this study, 0 was considered as no pain, 1-3 as mild pain, 4-6 as moderate pain, 7-9 as severe pain and 10 as the worst possible pain. Those belonging to the study group were given intravenous Fentanyl of 1-5 mcg/Kg as pre-emptive analgesia 30-60 minutes before surgery. After the pre-emptive analgesia their pain intensities were re-scored. However, those in the control group, after their pre-operative pain was scored, received the routine anaesthesia care as practiced by the hospital.

Prior to induction of anaesthesia, basic intraoperative monitors (ECG, pulse oximeter, and non-invasive blood pressure) were applied and the baseline vital signs (blood pressure, heart rate, respiratory rate and body temperature) checked and recorded. General anaesthesia with intubation was used for all patients. Induction of anaesthesia was established with 0.02 mg/kg of midazolam, 3 mcg/kg of fentanyl, 1-2.5 mg/kg of Propofol or 1-2 mg/kg of ketamine and 1mg/kg of succinylcholine. Intubation was undertaken and subsequently, anaesthesia was maintained with Isoflurane at 2-3% in oxygen.

During surgery, two nurse anaesthetists, trained in the use of the APPS, undertook to independently monitor for pain indicators and score pain intensity using the APPS for all patients in the study group. Pain was initially scored if there was ≥ 30% increase in two or more baseline vital signs/pain indicators, as observed on the patient's monitor and outlined in the APPS. Following the initial pain score, the two nurse anaesthetists were blinded to fentanyl (1 mcg/kg) treatment (were asked to leave the operation room and return after 5 minutes). After 5-15 minutes of treatment, they were asked to re-evaluate pain using the APPS. The physiological and behavioural responses that were assessed using this scale were blood pressure, heart rate, respiratory rate, facial expression, body movement, and muscle tension. Each parameter was scored on the scale of 1-3. The total scores of the six parameters enumerated above were determined during the period of pain assessment, and the total scores ranged from 6-18. 6-9 was interpreted as non-mild pain, 10-14 as moderate to severe pain, and 15-18 as severe pain.

Both the study and control groups had their immediate postoperative pain intensities assessed, using the numerical pain rating scale. Their immediate postoperative pain scores were assessed after each patient had a score of 2 on the Ramsay Sedation Scale (i.e. 1= anxious, agitated and restless, 2 = cooperative, oriented and tranquil, 3 = responsive to commands only, 4 = brisk response to light glabellar tap or loud auditory stimulus, 5 = sluggish response

to light glabellar tap or loud auditory stimulus, and 6 = no response to light glabeller tap or loud auditory).

2.6 Statistical Analysis of Data

Data gathered were double-entered into Microsoft Excel version 2010 for Windows and validated for data entry errors. The data analysis was conducted using SPSS version 20.0 for Windows. The statistical package was set at 95% confidence interval and p-value <0.05 was considered as statistically significant. Means and standard deviations were calculated for continuous variables, while frequencies and percentages were calculated for categorical variables.

3. RESULTS

Out of the 60 respondents who took part in the study, 19 (31.75%) of them were females and the remaining 41 (68.3%) were males. Of the 60 participants in this study, those who were of ages less than or equal to 20 years were 13 (21.7%), 25 (41.7%) of them were 21-40 years of age, 15 (25%) respondents were between the ages of 41-60 years, and the rest of the 7 (11.7%) patients were 61 years and above. Out of the six main categories of surgical procedures that were carried out in this study, 7% of the respondents went through External fixation and debridement, 42% went through Open Reduction and Internal Fixation (ORIFs), while 5% went through Sequestrectomy. 8% of the respondents also went through Amputation, 5% of them had removal of plates and screws plus skin grafting and 33% of the respondents had abdominal surgeries.

3.1 Perioperative Pain Assessment

The numerical pain rating scale was used to assess patient's pain intensity in the ward prior to their being in the operating theatre. Pain intensity scores ranged from no pain to worst pain, and 33% of the study group and 13% of the control group described their pain as severe. Among those who described their pain as worst were 3% for the study group and 10% for the control group. After pre-emptive analgesia for the study group, 7% scored severe and none scored worst pain. The control group was made to receive the routine anaesthesia care as practiced by the institution (Table 1).

During the intra-operative period, pain was monitored and the pain intensity was scored for the study group using the APPS. The APPS scored pain intensity ranges from no pain to severe pain with 5% of respondents scoring no pain and 57% scoring mild pain, 20% scoring moderate pain, and 8% scoring severe pain. After fentanyl treatment, pain intensity was re-assessed and APPS realised, with 83% of the study group recording no pain, 17% recording mild pain, and none scoring severe or worst pain (Table 1).

During the immediate postoperative pain assessment of all the 60 participants in this study, 10 of the respondents in the study group (A) had mild pain compared to 3 respondents in the control group (B), 16 respondents in the study group (A) also had moderate pain as against 11 respondents in the control group (B), 4 members of the study group scored severe pain whereas 14 members in the control group (B) had severe pain. Nobody in the study group (A) experienced worst pain but 2 patients in the control group experienced worst pain (See Table 1).

3.2 Comparing Perioperative Pain Scored

The used of our standardized pain rating scale and pain management techniques in this study promoted a significant difference in pain intensity among the two groups at the immediate post-operative period. This study realized an initial means preoperative pain score of 5.4 for the study group and 4.0 for the control group. At the immediate postoperative period, pain was assessed using the numerical pain rating scale. This study realized a mean pain intensity score of 4.5 for the study group as against a pain intensity score of 6.4 for the control group. The immediate postoperative pain intensities scored were compared using the independent sample T-test and a P value of less than 0.001 ($p<0.001$) was realized (Table 2).

3.3 Age, Sex & Dosage of Fentanyl Received

Among the control group, 11 (37.9%) patients consisting of 8 (27.6%) male and 3 (10.3%) female received 150mcg or less of fentanyl. Out of the 11 patients, 4 (13.8%) were within 41-60 years of age, 3 patients were between 21-40 years of age, 3 of the patients were 20 years of age or less and 1 was in the category of 61 and above years of age. Patients who received a total dose of 151-300 mcg were 17 (58.6%);

Table 1. Perioperative pain intensity scored

	Pain Intensity	A		B	
		N	%	N	%
Pre-operative pain score before analgesia (NPRS)	No pain	2	6.7%	8	26.7%
	Mild	5	16.7%	6	20.0%
	Moderate	12	40.0%	9	30.0%
	Severe	10	33.3%	4	13.3%
	Worst	1	3.3%	3	10.0%
Pre-operative pain score after pre-emptive analgesia (NPRS)	No pain	5	16.7%	0	0.0%
	Mild	17	56.7%	0	0.0%
	Moderate	6	20.0%	0	0.0%
	Severe	2	6.7%	0	0.0%
	Worst	0	0.0%	0	0.0%
Intra-operative pain intensity score before analgesia (APPS)	No-mild pain	5	16.7%	0	0.0%
	Moderate - sever pain	25	83.3%	0	0.0%
	Severe pain	0	0.0%	0	0.0%
Intra-operative pain intensity score after fentanyl treatment (APPS)	No-mild pain	25	83.3%	0	0.0%
	Moderate - sever pain	5	16.7%	0	0.0%
	Severe pain	0	0.0%	0	0.0%
Post-operative pain intensity score (NPRS)	No pain	0	0.0%	0	0.0%
	Mild	10	33.3%	3	10.0%
	Moderate	16	53.3%	11	36.7%
	Severe	4	13.3%	14	46.7%
	Worst	0	0.0%	2	6.7%

A*= Study group,* ***B****= Control group,* ***APPS****= Anesthetized Patient Pain Scale,* ***NPRS*** *=Numerical Pain Rating Scale*

Table 2. Independent sample T-test

Variable	Group	N	Mean ±SD	p-value
Pre-op pain description before analgesia	A	30	5.37±2.566	0.083
	B	30	4.00±3.384	
Post-operative pain description/score	A	30	4.57±1.832	<0.001
	B	30	6.47±2.080	
Duration of surgery	A	30	107.00±30.148	0.918
	B	30	106.10±37.140	

*A = Study group, B= Control group, N= number of respondents. *p<0.05, there was a statistically significant difference (p=<0.001) in the mean post-operative pain score for the study groups*

12 (41.4%) of them were male and 5 (17.2%) female. None of the control group received a total analgesic dose of 301-450 mcg. This study realized 1 male among the control group at the age of 61 years and above category who received a total dose of analgesic 401 mcg and above (Table 3).

4. DISCUSSION

Accurate pain assessment is important to ensure optimal pain management by avoiding underdosage or the adverse effects associated with overdosage of analgesic agents. This study revealed that participants who had their perioperative pain periodically assessed with standardised pain rating scales and who were administered interventional analgesic therapy (study group=A), had better postoperative pain outcomes compared to the control group because of the accurate pain assessment and the right dosage of analgesic given. This is evidenced by the mean postoperative pain scores of 4.57 for the study group and 6.47 for the control group which was statistically significant (P<0.001). This study lends validity to the statement by Welchek et al. [14] that without accurate pain assessment, it is almost impossible to guarantee optimal pain relief for patients. A previous study by Kampo et al. [13] further highlighted that failure to conduct a proper intraoperative pain assessment leads to the provision of suboptimal analgesia for patients, and also contributes to significant postoperative pain. Out of 246 patients, studied by Kampo et al. [13] using a cerebral state monitor and the Anaesthetized Patient Pain Scale, 69% experienced moderate to severe pain, despite adequate hypnosis.

Table 3. Age, sex & total dosage of perioperative fentanyl received

Group	Fentanyl in mcg		Sex			Age				
			Male	Female	Total	<= 20	21 - 40	41 - 60	61+	Total
A	<= 150.00	N	1	0	1	0	1	0	0	1
		%	3.3%	0.0%	3.3%	0.0%	3.3%	0.0%	0.0%	3.3%
	151.00 - 300.00	N	13	6	19	7	9	1	2	19
		%	43.3%	20.0%	63.3%	23.3%	30.0%	3.3%	6.7%	63.3%
	301.00 - 450.00	N	6	4	10	1	3	5	1	10
		%	20.0%	13.3%	33.3%	3.3%	10.0%	16.7%	3.3%	33.3%
	451.00+	N	0	0	0	0	0	0	0	0
		%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
B	<= 150.00	N	8	3	11	3	3	4	1	11
		%	27.6%	10.3%	37.9%	10.3%	10.3%	13.8%	3.4%	37.9%
	151.00 - 300.00	N	12	5	17	2	9	4	2	17
		%	41.4%	17.2%	58.6%	6.9%	31.0%	13.8%	6.9%	58.6%
	301.00 - 450.00	N	0	0	0	0	0	0	0	0
		%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	451.00+	N	1	0	1	0	0	0	1	1
		%	3.4%	0.0%	3.4%	0.0%	0.0%	0.0%	3.4%	3.4%

A= Study group, B= Control group

According to Edward [15], pre-emptive analgesia is an inseparable part of pain management in patients undergoing surgery. This is because it helps to provide adequate and effective analgesia prior to a surgical incision in order to ablate the centralisation of surgical pain and to decrease postoperative analgesic demands. One of the pain management techniques that were employed in this current study was the administration of pre-emptive analgesia. Those in study group received 1-5 mcg of Fentanyl for about 30-60 minutes before surgical incision was made while control group received the routine anaesthesia care as practiced in the hospital (no pre-emptive analgesia).

There was some significant difference, in terms of the postoperative pain, between study group and control group with a P-value <0.001. These findings are consistent with those of Edward [15] and the notion of the importance of pre-emptive analgesia, as indicated above. The results from this study are also compatible with the findings of Hyun et al. [16]. In their study, eighty-two patients were divided into two groups. The first group that was made up of forty-three participants were given pre-emptive pain medication as part of their pain management while the remaining thirty-nine (second group) were not given pre-emptive pain medication. Those in the first group had scored lower pain levels than the second group on postoperative days one and four.

Patients in the study group had a mean analgesic (fentanyl) consumption of 285 mcg as against a mean analgesic consumption of about 182 mcg for control group. This is an indication that those who had standardised perioperative pain assessment as part of their pain management received higher doses of analgesia than those who received the routine anaesthesia care. Those respondents in study group had better postoperative pain outcome compared to patients in control group, since only 4 respondents in study group had severe postoperative pain, compared to 14 patients in control group. No patient in the study group experienced worst pain, whereas 2 patients in control group experienced worst pain. These findings are consistent with the findings of Schofield [17], that without adequate and proper pain assessment, patients are more likely to receive inadequate or inappropriate analgesia, both of which can pose deleterious pain outcomes to those patients.

Despite the fact that patients belonging to study group registered lower postoperative pain levels relative to those of control group, it was observed that even their mean postoperative pain score of 4.57 was much higher compared to a postoperative pain score of 2.43 in a previous study that was conducted by Wellisch et al. [18], that used the technique of multimodal pain management. The study of Wellisch et al. [18] is further strengthened by the findings of Sivrikaya [19], and Parvizi et al. [20], that a multimodal pain management technique ensures holistic pain control and reduces postoperative pain to guarantee early mobilisation, early enteral nutrition, minimisation of postoperative stress and limiting of the adverse effects associated with the use of a single analgesic agent such as opioids [21].

According to Welchek et al. [14], pain is a very common medical complaint and is one of the basic reasons for which patients seek medical care in the USA. It has been estimated that 50% to 80% of hospitalised patients have considerable pain, irrespective of the reason(s) for admission. The findings of the current study further support the findings of Welchek et al. [14], whereby only 10 participants (about 17%), out of a total of 60 participants who took part in this study scored no pain, 11 (about 18%) scored mild pain, 21 (35%) had moderate pain, 14 (23%) scored severe pain, while 4 respondents, representing about 7%, expressed worst pain during preoperative assessment. This means that about 90% of the participants recruited for this study expressed some sort of pain, even before surgery.

5. RECOMMENDATIONS

Based on the outcomes of this study, it is recommended that to ensure adequate perioperative pain management, every hospital should design a pain management protocol, with preventive analgesia and perioperative pain assessment being an integral and mandatory part of that protocol.

6. CONCLUSION

In brief, the results from this study and the review of other related literature have demonstrated that implementing the concept of perioperative pain assessment with standardised pain rating tools and administering pre-emptive analgesia will contribute to optimising perioperative pain control and minimising postoperative pain-related complications. However, it is clear that the use of these techniques alone is not enough to overcome the complexities and challenges associated with perioperative pain management. Therefore, to achieve a desirable perioperative pain control, these plausible pain management techniques (perioperative pain assessment and the use of preventive analgesia) should be incorporated into other concepts, such as the use of multimodal pain management involving the use of Spinal Analgesia, Epidural Analgesia, Peripheral nerve blocks, Non-Steroidal Anti-inflammatory Drugs (NSAIDs), Acetaminophen, local analgesics, and Patient-Controlled Analgesia (PCA).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/13824