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Research Article

Multimodal analgesia after upper limb orthopedic surgeries: Patient controlled intravenous low dose tramadol analgesia with or without intravenous acetaminophen – A comparative study

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Abstract This study was designed to evaluate the effects of addition of acetaminophen to a low dose tramadol patient controlled intravenous analgesia after unilateral upper limb orthopedic surgeries under general anesthesia.

Methods: 120 Adult patients ASA I and II undergoing unilateral upper limb orthopedic surgeries under general anesthesia were randomly allocated into two groups:

Group TA (n = 60): received postoperative iv tramadol PCA boluses of 10 mg and iv acetaminophen1 g/8 h.

Group T (n = 60): received postoperative iv tramadol PCA boluses of 10 mg.

Volume of tramadol (mg)consumed ,severity of postoperative pain at rest using VAS, postoperative systolic, diastolic arterial blood pressure and heart rate in 24 h, patient satisfaction ,adverse effects (sedation, nausea, vomiting, hypotension, respiratory depression) were recorded.

Results: Volume of tramadol (mg) consumed, severity of postoperative pain at rest using VAS 24 h were statistically significantly higher in group T, postoperative systolic , diastolic arterial blood pressure and heart rate, adverse events showed no statistical significant differences between the two groups, patient satisfaction was more in group TA.

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Conclusion: The addition of acetaminophen to a low dose tramadol iv PCA as a multimodal analgesic approach provided satisfactory pain control than tramadol iv PCA alone after unilateral upper limb orthopedic surgeries under general anesthesia.

1. Introduction

Intravenous patient-controlled analgesia is a method for postoperative analgesia which allows patients to titrate analgesics in amounts proportional to perceived pain stimulus [1].

Multimodal approaches to pain management involves the use of adjunctive pain control methods and less dependence on opioids to avoid their adverse effects e.g. respiratory, cardiovascular depression, and PONV [2].

Opioids specially morphine are the gold standard for postoperative pain control [1] but, it has a high risk of side-effects e.g. nausea, vomiting, pruritus, urinary retention [3].

Tramadol hydrochloride is an analgesic drug acting at central and peripheral m-opioid and monoaminergic receptors [4], when used in PCA, it provide effective analgesia after major orthopedic surgery [5].

Intravenous acetaminophen is an effective analgesic drug for postoperative pain control [6,7] and when added to PCA morphine induced a significant morphine sparing effect [8].

Previous reports using different doses of PCA tramadol showed conflicting results about the optimum dose, efficacy and adverse events, a study by Emir et al. [9] concluded that PCA using tramadol boluses and continuous infusion resulted in lower pain score, less side effects. ,another study used a high dose of tramadol pca boluses and infusion provided good pain relief but high incidence of post operative nausea and vomiting [10].

We hypothesized that addition of intravenous acetaminophen as a multimodal analgesic technique to a low dose tramadol pca boluses only without continuous infusion can enhance analgesic efficacy and reduce tramadol adverse events mainly PONV after unilateral upper limb orthopedic surgeries.

2. Patients and method

After approval of the ethical committee at Al Razi orthopedic hospital (Kuwait), a written informed consent obtained from 120 ASA I and II males and females patients aged 18–50 years old, planned for elective and emergency unilateral upper limb orthopedic surgeries under general anesthesia from January 2010 to May 2011.

Those with history of use of antidepressant drugs, epilepsy, history of PONV, allergic reaction to the drugs used in the study or having mental or psychiatric disorders preventing the use of PCA device were excluded from the study.

The study protocol, and the Visual Analogue Scale (VAS) for pain, the use of PCA device were explained to each patient during the preoperative visit.

All patients were premedicated with oral midazolam 0.1 mg/kg, 30–60 min before surgery. In the operating room, a intravenous cannula was inserted and 10 ml/kg normal saline was infused. Electrocardiogram pulse oximetry, and non-invasive arterial blood pressure at 5 min intervals were applied.

General anesthesia was induced in all patients with i.v. propofol, fentanyl, cisatracurim, oral cuffed endotracheal tube, anesthesia was maintained with oxygen 50%, nitrous oxide 50%, sevoflorane, additional doses of cisatracurium, mechanical ventilation with maintenance of endtidal carbondioxide 35–40 mm Hg, all patients were given tramadol 2 mg/kg for intraoperative analgesia.

At the end of surgery neuromuscular blockade was reversed with neostigmin and atropine IV, the trachea was extubated when the patient respond to commands, all patient were transferred to PACU where they were monitored. The postoperative pain at rest was assessed using Visual Analogue Scale (VAS), where zero score corresponds to no pain and 10 to the maximum or worst pain. Patients were then instructed to start using patient-controlled the PCA pump (CADD-Legacy® PCA, model 6300 Ambulatory infusion pump; Deltec, Inc. St Paul, MN 55112 USA, 40-3920-51B), Fig. 1.

PCA pump was programmed to deliver tramadol boluses of 10 mg, lockout interval 20 min, no background infusion, maximum doses per hour 30 mg.

Patients were randomly allocated into two equal sized groups:

Group TA (n = 60): received postoperative iv tramadol PCA boluses of 10 mg and iv acetaminophen1 g/8 h (Perfalgan® laboratories UPSA).
Group T (n = 60): received postoperative iv tramadol PCA boluses of 10 mg only.

If adequate analgesia was not obtained, rescue analgesia of 75 mg i.m. diclofenac sodium was given.

The following parameters were evaluated and recorded in the anesthesia sheets, PCA sheets:

1. Patient characteristics, operative data.
2. The severity of postoperative pain at rest measured at 8, 16, and 24 h postoperatively using (VAS).

Figure 1 CADD-Legacy PCA machine.

3. Postoperative systolic, diastolic arterial blood pressure, heart rate at 8, 16, and 24 h, Hypotension was considered if systolic BP pressure was less than 90 mm Hg.
4. Volume of tramadol consumed (mg) in 24 h.
5. Number of patients complaining from postoperative nausea and vomiting .Rescue antiemetic metoclopramide (10 mg i.v. every 8 h), then ondansetron (4 mg i.v.) was given if nausea or vomiting did not disappear.
6. Respiratory depression (RR less than 8).
7. Sedation : was assessed with a five-point scoring scale (0 = fully awake; 1 = drowsy, closed eyes; 2 = asleep, easily aroused with light tactile stimulation or a simple verbal command; 3 = asleep, arousable only by strong physical stimulation; and 4 = unarousable).[11].
8. Grade of Patients' satisfaction (good/fair/unsatisfactory).

Statistical analysis: data are presented as mean (SD) or median (range),number and percentage as appropriate student *t*-test was used: for comparison between means of two groups, Mann–Whitney *U* test for nonparametric data, *P* values <0.05 were considered statistically significant. Statistical package for social science (SPSS) software version 15 was used.

3. Results

All patients completed the study, patient's characteristics and operative data showed no statistical significant difference between the two studied groups, Table 1.

Severity of postoperative pain at rest using VAS 24 h was statistically significantly higher in group T than group TA, Table 2.

Table 1 Patient characteristics and operative data in the studied groups. Data presented as mean ± SD, number.

	Group TA (n = 60)	Group T (n = 60)
Age (years)	31.6 ± 8.7	29.6 ± 9.7
Gender (M/F)	(52/8)	(54/6)
ASA (I/II)	(53/7)	(54/6)
Weight (kg)	82.8 ± 7.4	82.3 ± 8.9
Height (cm)	169.9 ± 8.0	173.4 ± 8.5
Duration of surgery (min)	85.12 ± 15.56	82.12 ± 13.47

No statistical significant differences between the studied groups.
Group TA: iv tramadol PCA boluses of 10 mg and iv acetaminophen1 g/8 h.
Group T: iv tramadol PCA boluses of 10 mg.

Table 2 Postoperative Visual Analogue Scale (VAS) data presented as median and range.

VAS (h)	Group TA (n = 60)	Group T (n = 60)
8	3 (2–4)	4 (2–5)[a]
16	2 (1–3)	3 (2–5)[a]
24	2 (1–3)	3 (2–4)[a]

Group TA: iv tramadol PCA boluses of 10 mg and iv acetaminophen 1 g/8 h.
Group T: iv tramadol PCA boluses of 10 mg.
[a] Statistically significant.

Table 3 Postoperative systolic arterial blood pressure (mm Hg), data presented as mean ± SD.

Time (h)	Group TA (n = 60)	Group T (n = 60)
8	133.33 ± 5.7	136.66 ± 5.4
16	132.32 ± 5.5	134.54 ± 2.3
24	135.5 ± 5.8	136.4 ± 4.9

No statistical significant differences between the studied.
Group TA: iv tramadol PCA boluses of 10 mg and iv acetaminophen 1 g/8 h.
Group T: iv tramadol PCA boluses of 10 mg.

Table 4 Postoperative diastolic arterial blood pressure (mm Hg), data presented as mean ± SD.

Time (h)	Group TA (n = 60)	Group T (n = 60)
8	83.56 ± 5.4	85.14 ± 1.3
16	82.44 ± 2.4	83.47 ± 1.8
24	80.57 ± 3.5	81.00 ± 1.6

No statistical significant differences between the studied groups.
Group TA: iv tramadol PCA boluses of 10 mg and iv acetaminophen 1 g/8 h.
Group T: iv tramadol PCA boluses of 10 mg.

Table 5 Postoperative heart rate (Bpm), data presented as mean ± SD.

Time (h)	Group TA (n = 60)	Group T (n = 60)
8	87.3 ± 3.4	88.2 ± 3.7
16	80.23 ± 4.6	81.54 ± 3.5
24	78.15 ± 5.7	79.21 ± 3.4

No statistical significant differences between the studied groups.
Group TA: iv tramadol PCA boluses of 10 mg and iv acetaminophen 1 g/8 h.
Group T: iv tramadol PCA boluses of 10 mg.

Table 6 Postoperative tramadol consumed (mg) Adverse events, sedation scores, patient satisfaction, patients needed for rescue analgesics,data presented as mean ± SD or number, number and (%).

	Group TA (n = 60)	Group T (n = 60)
Tramadol consumed in 24 h (mg)	216 ± 44.5	262.7 ± 28.4[a]
Nausea n (%)	6(4.8)	12(7.2)
Vomiting n (%)	2(1.2)	6(3.6)
Respiratory rate <8 n (%)	0(0)	0(0)
Hypotension n (%)	0(0)	0(0)
Sedation score (0/1/2/3/4)	(59/1/0/0)	(58/2/0/0)
Patient satisfaction: (good/fair/unsatisfactory)	(55/3/2)	(50/6/4)
Need for recue analgesics n (%)	3(1.8)	10 (6)[a]

Group TA: iv tramadol PCA boluses of 10 mg and iv acetaminophen1 g/8 h.
Group T: iv tramadol PCA boluses of 10 mg.
[a] Statistically significant.

Postoperative systolic, diastolic arterial blood pressure and heart rate showed no statistical significant differences between the two groups, Tables 3–5.

Volume of tramadol (mg) consumed was statistically significantly higher in group T than group TA, adverse effects were higher in group T than group TA, but not statistically significant ,patient satisfaction was more in group TA than group T, number of patient needed rescue analgesic were statistically significant higher in group T, Table 6.

4. Discussion

The present study demonstrated that the addition of acetaminophen to a low doses tramadol iv PCA was associated with better pain control, less tramadol consumed, less number of patient needed rescue analgesic, more patient satisfaction and reduction of the incidence of the PONV than patients received iv pca tramdol alone although the incidence of PONV was not statistically significant difference between the two groups, no cardiovascular and respiratory adverse effects reported in the two groups.

The use of non-opioid analgesics reduce opioid-induced side-effects [12,13], acetaminophen is non-opioid analgesic with a well-documented efficacy after different surgical procedures [14].

Previous study by Emir et al. [9] concluded that PCA using tramadol-acetaminophen after spine surgery, resulted in lower pain score, less side effects, reduced the analgesic requirement and the total dose of tramadol consumed than PCA tramadol alone although they used a higher doses and continuous infusion of tramadol in all patients, in our study we used a low dose of tramadol with no background infusion and this resulted in low pain score and less tramadol consumed.

The low dose we used resulted in low incidence of PONV as compared to a previous study in 30 patients underwent elective and emergency abdominal surgeries and postoperative iv pca tramadol was used it provided good pain relief but post operative nausea and vomiting was observed in 30% of the patients, no cardiovascular and respiratory depression reported in any patient but their doses were tramadol 30 mg bolus with base line infusion of 10 mg/hour and lock-out period of 20 min [10], it was also reported in major orthopedic surgeries that a high dose of tramadol causing decreased patient satisfaction due to PONV [5].

In this study acetaminophen has a tramadol sparing effect with reduction of adverse events like sedation previous studies have demonstrated the opioid-sparing effect of non-opioid analgesics [15–18] also it was concluded that addition of acetaminophen to pca morphine had a morphine sparing effect [10,15–17].

5. Conclusion

The addition of acetaminophen to a low dose tramadol iv PCA as a multimodal analgesic approach provided satisfactory pain control than tramadol iv PCA alone and reduced tramadol consumption after unilateral upper limb orthopedic surgeries under general anesthesia.

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