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The Role of Patient-Controlled Apparatus for Sedation in the Emergency Department

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Abstract

Aim: Hand trauma is a fairly common cause of emergency unit admissions. Various analgesic and sedative agents are used to decrease pain and anxiety during minor surgical procedures for hand trauma patients and provide more comfortable conditions for the surgeon. The aim of this study was to investigate the potential role of patient-controlled sedation (PCS) during surgical procedures done under local anesthesia for hand trauma in the emergency department

Materials and Methods: Forty ASA I-II (Assignment of the American Society of Anesthesiologists) patients who visited the emergency unit with hand trauma were randomized to 2 groups of 20 patients each. The control group received 1 μg/kg of fentanyl (IV) and 0.028 mg/kg of midazolam (IV). Additional 1 mg doses of midazolam were given by the anesthesiologist to keep the sedation level between 3 and 4. In the PCS group, the midazolam was administered after programming the apparatus. The settings were as follows: loading dose: 0.028 mg/kg, bolus dose 1 mg, lock-out period: 5 min and basal infusion rate: 0. The loading dose was given before local anesthesia. All patients received prilocaine hydrochloride (Citanest 2%, 10 mL) for local anesthesia. The systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), oxygen saturation (SpO_2) and respiration rate (RR) were measured before intervention and at 2, 3, 5, 10, 15, 20 and 30 minutes.

Results: There were no differences in the demographic characteristics, operation and discharge times in the two groups ($p>0.05$). No cardiovascular or respiratory instability was observed in any patient, and SpO_2 remained over 95% for all. The SBP, DBP, HR and SpO_2 did not differ significantly ($p>0.05$). Although the sedation levels of all patients were satisfactory, the sedation levels of the control group were significantly lower at 5 and 15 minutes ($p<0.05$). The total midazolam dose was 4.3+1.1 in the control group and 4.0+0.8 in the PCS group. The patient satisfaction rate was 95% in the PCS group and 80% in the control group ($p>0.05$).

Conclusions: The two regimens did not differ with respect to hemodynamic changes, sedation levels and patient satisfaction. Therefore, PCS may be an acceptable alternative for surgical procedures performed using local anesthesia.

Key Words: Hand trauma, patient-controlled sedation, emergency department.

Introduction

HAND TRAUMA is a fairly common cause of emergency unit admissions. Various analgesic and sedative agents are used to decrease pain and anxiety during minor surgical procedures for these patients and to provide more comfortable conditions for the surgeon. The human hand provides the physical and physiological basis for creativity and precision through its mobility and sensation. It is also vulnerable to injury; an estimated 5% of emergency department visits are for the evaluation and treatment af hand injuries (1, 2).

Pain control is a vital component of the proper examination and treatment of acute hand injuries. Local anesthesia can be provided before close inspection, cleaning and surgical application, and repair of a wound or injury. For an extensive area of injury, a regional block can provide adequate anesthesia. If relaxation and systemic pain control are neeeded to care for a patient's injury, conscious sedation may be best (3).

Conscious sedation is a technique in which the use of drugs produces a state of depression of the central nervous system, enabling treatment to be carried out; verbal contact and protective reflexses are maintained. The technique has been widely used to supplement local anesthesia during exodontia, especially for very anxious patients (4).

Patient-controlled sedation offers the possibility of direct patient involvement in determining sedation requirements, in a manner similar to "patient-controlled anaesthesia" (5–7).

The aim of this study was to investigate the potential role of the patient-controlled sedation (PCS) device during surgical procedures performed using local anesthesia for hand trauma in the emergency department. We compared the effectiveness of patient-controlled sedation and emergency resident-controlled midazolam sedation, using a randomized prospective study.

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Materials and Methods

This study was approved by the institutional review board of our hospital. Forty ASA I-II (Assignment of the American Society of Anesthesiologists) patients admitted for occupational hand trauma (ligament injuries and finger amputations) were included. Patients with only superficial skin and subcutaneous tissue cuts were excluded. All patients gave informed consent to participate. They were randomized to the intravenous sedation group (n=20) or the PCS group (n=20). The surgical procedures were performed by a second-year orthopedics resident. Follow-up was conducted by emergency room physicians.

A 22G Angiocath (Becton Dickinson Vascular Access, Sandy, UT) was placed in all patients. In the intravenous sedation group, patients were given 1 μg/kg of fentanyl and 0.028 mg/kg of midazolam, and the operation was performed using local anesthesia (Citanest 2%, 10 mL). The sedation level was monitored according to the Modified Observer's Assessment of Alertness/Sedation Scale (OAAS) (8) and additional 1 mg doses of midazolam were administered to maintain a sedation level of 3 to 4, as seen in Table 1.

The patient-controlled sedation apparatus enables the patient to adjust the level of sedation. Before the operation, the loading dose (the amount of drug required to induce initial sedation just after the apparatus is turned on), the bolus dose (the amount of drug the patient is allowed to self-administer at intervals), the lock-out duration (the interval during which the apparatus does not respond to the command of the patient), and the basal infusion rate (the amount of drug administered continuously) were set up. In the PCS group, midazolam was prepared at a concentration of 0.2 mg/dL; the loading dose was 0.028 mg/kg, bolus dose was 1 mg and lock-out time was 5 minutes. Basal perfusion was not given. All patients received instruction on using the apparatus. Before the operation and administration of local anesthesia, 1 μg/kg of fentanyl was administered and the loading doses were given via the apparatus.

Physicians evaluated each patient's affect, ECG, and respiration. Oxygen saturation (SpO_2) was monitored continuously by pulse oximetry for every patient. The systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiration rate (RR) were measured before intervention and at 2, 3, 4, 10, 15, 20 and 30 minutes. The time of discharge was determined according to the modified postanesthetic discharge scoring system (MPADSS) (9) (Table 2). The interval to MPADSS≥ 9 was recorded as the time to discharge.

The sedation scores were evaluated by the Mann-Whitney U-test, and vital signs, operation time, and time to discharge were compared by the unpaired t-test. Probability values less than 0.05 were considered significant.

Results

A majority of the hand trauma patients had extensor tendon cuts and finger amputations. The distribution of the diagnoses in the two groups was similar.

There were no differences between the demographic characteristics or the operation and dis-

TABLE 1
OAAS (Observer's Assessment of Alertness/Sedation) Scores

Assessment Categories				
Responsiveness	**Speech**	**Facial expression**	**Eyes**	**Composite score Level**
Responds readily to name spoken in normal tone	Normal	Normal	Clear, no ptosis	5 (Alert)
Lethargic response to name spoken in normal tone	Mild slowing or thickening	Mild relaxation	Glazed or mild ptosis (less than half the eye)	4
Responds only after name is called loudly and/or repeatedly	Slurring or prominent	Marked relaxation (slack jaw)	Glazed and marked ptosis (half the eye or more) slowing	3
Responds only after mild prodding or shaking	Few recognizable words	_	_	2
Does not respond to mild prodding or shaking	_	_	_	1 (Deep sleep)

TABLE 2
Modified Postanesthetic Discharge Scoring System

	Score
Vital Signs: When compared with initial evaluation	
20%	2
20–40%	1
40% or more	0
Ambulation: Patient can walk, no vertigo	2
Patient can walk with assistance	1
Patient can't walk, has vertigo	0
Nausea and Vomiting: Minimum	2
Moderate	1
Maximum	0
Pain: Minimum	2
Moderate	1
Maximum	0
Bleeding: Minimum	2
Moderate	1
Maximum	0
Total	**10**

charge times of the two groups (p>0.05) (Table 3). No cardiovascular or respiratory instability was observed in any patient and SpO_2 remained over 95% for all. The SBP, DBP, HR and SpO_2 did not show significant differences (p>0.05) (Figure). Although all sedation levels were satisfactory, the sedation levels of the control group were significantly lower at 5 and 15 minutes (p<0.05) (Table 4). The total midazolam dose was 4.3+1.1 mg in the control group and 4.0+0.8 mg in the PCS group. The patient satisfaction rate was 95% in the PCS group and 80% in the control group (p>0.05).

There was no evidence of cardiovascular or respiratory instability in either group. No patient in the PCS or the control group was sedated to a level deeper than full eyelid closure, with prompt response to verbal command.

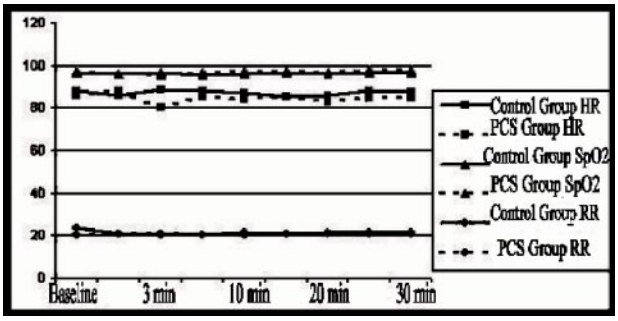

Fig. Correlation of some vital parameters between PCS groups and control groups.
PCS = patient-controlled sedation, HR = heart rate, SpO_2 = oxygen saturation, RR = respiration rate.

TABLE 3
Basic Characteristics of the Two Patient Groups

	Control Group (n=20)	PCS Group (n=20)	p
Age (year)	33±11	38±16	>0.05
Weight (kg)	72±7	72±10	>0.05
Length (cm)	170±2	171±5	>0.05
Operation time (min)	32.3±5	32.1±8	>0.05
Discharge time (min)	38.1±8	40.2±9	>0.05

PCS = patient-controlled sedation.

Discussion

A majority of the patients who visit the emergency department experience high levels of anxiety and severe pain. This situation becomes more problematic for patients who need to undergo minor surgical procedures. In addition, because of the pain and bleeding from the extremity, patients with hand injuries are very anxious about the possibility of limb loss. Sedation of these patients improves patient comfort and provides a more favorable setting for the physician. When applying local anesthesia, the physician uses analgesics and sedatives as he considers appropriate during the course of the procedure. The patient-controlled apparatus has been used successfully for postoperative pain treatment and for sedation in patients undergoing surgery under local anesthesia (10–14). However, we did not come across any studies on the use of the patient-controlled apparatus for the sedation and analgesia of hand trauma patients in the emergency department.

Lee at al. (15) compared PCS and IV sedation in elderly patients undergoing colonoscopy and concluded that PCS was safer. In another study, the PCS-treated group required significantly less medication when compared to a matched group of patients receiving conventional intramuscular treatment (16). Some studies compared the analgesic efficacy of

TABLE 4
Levels of Sedation. Mean (SD)

	Control Group	PCS Group	p
Initial	5.0±0.0	5.0±0.0	>0.05
1 min	3.45±0.68	3.50±0.51	>0.05
3 min	3.35±0.67	3.62±0.50	>0.05
5 min	3.35±0.67	3.93±0.25	<0.05
10 min	3.55±0.68	3.87±0.34	>0.05
15 min	3.65±0.58	4.06±0.44	<0.05
20 min	3.75±0.44	4.00±0.36	>0.05
25 min	3.95±0.22	4.00±0.0	>0.05
30 min	3.95±0.22	4.00±0.0	>0.05

PCS = patient-controlled sedation.

PCS with that of conventional treatments and found that with PCS more effective analgesia can be achieved with smaller amounts of opioid and that the frequency of side effects was lower (17–19).

Pac-Soo et al. (20) compared midazolam and propofol with PCS in patients undergoing cataract surgery under local anesthesia and concluded that both agents were appropriate and that midazolam allowed better control of blood pressure intraoperatively. Midazolam was used successfully in the present study. It is the benzodiazepene of choice, as it has a rapid onset and a short elimination half-life of 1.5–3.5 hours, and is void of significant pharmacolgically active metabolites (21). Midazolam is a popular drug for minor surgical procedure because of its minimal respiratory and cardiovascular depressant effects, amnestic properties, the absence of pain during its injection, and its short duration of action (13, 14).

Uyar et al. (10) used PCS in patients undergoing extracorporeal shock wave lithotripsy and compared the analgesic and sedative effects of alfentanil-propofol with those of alfentanil-midazolam. Patient satisfaction was high in both groups. Ghouri et al. (11) compared the perioperative efficacy of alfentanil, midazolam and propofol in patients undergoing minor surgical procedures under local anesthesia and reported equivalent results.

Zelcer et al. (21) compared PCS and conventional physician-controlled analgesia in patients undergoing vaginal ovum pick-up procedure and concluded that both methods were equally effective in terms of patient comfort and safety. In the present study, both methods achieved adequate sedation, patient safety and patient satisfaction.

Conclusion

PCS is a reliable method of sedation that ensures patient comfort. Administration of opioid analgesics in addition to local anesthesia to hand trauma patients undergoing surgical procedures significantly enhanced patient satisfaction. The lower amount of midazolam used, the higher level of patient satisfaction and the absence of major changes in cardiovascular and respiratory parameters and consciousness suggest that sedation with PCS may be an option for patients undergoing minor surgical procedures. However, PCS does not improve hemodynamic parameters and sedation levels, and PCS apparatus is required to be set up before the surgical application. Because of these conditions, PCS may not be very practical for use in the emergency room.

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