Original Article

Comparative evaluation of adding different opiates (morphine, meperidine, buprenorphine, or fentanyl) to lidocaine in duration and quality of axillary brachial plexus block

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Abstract

Background: There is no agreement about the effect of adding opioids to local anesthetics in peripheral nerve blocks. The aim of this study was to investigate the effect of adding different opioids with equipotent doses of lidocaine in axillary brachial plexus block using ultrasonography and nerve locator guidance.

Materials and Methods: In a prospective, randomized, double-blind clinical trial study, 72 adult patients aged 18–65 years old scheduled for orthopedic surgery of the forearm and hand with axillary brachial plexus block were selected and randomly allocated to four groups. Meperidine (pethidine), buprenorphine, morphine, and fentanyl with equipotent doses were added in 40cc of 1% lidocaine in P, B, M, and F groups, respectively. The onset and duration of sensory and motor blocks, severity of patients' pain, duration of analgesia, hemodynamic and respiratory parameters, and adverse events (such as nausea and pruritus) during perioperative period were recorded.

Results: The onset time for the sensory block was similar in the four groups. The onset time for the motor block was significantly faster in morphine and pethidine groups ($P = 0.006$). The duration of sensory and motor blocks was not statistically different among the four groups. The quality of motor blockade was complete in 100% of patients receiving pethidine or morphine and 77.8% of patients receiving buprenorphine or fentanyl ($P = 0.021$).

Conclusion: In the upper extremity surgeries performed under axillary brachial plexus block addition of morphine or pethidine to lidocaine may be superior to other opioids (i.e. fentanyl and buprenorphine) due to better quality and quantity of motor blockade and faster onset of the block.

Key Words: Axillary block, brachial plexus, opiates, perioperative pain

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INTRODUCTION

Regional anesthesia is one of the well-known anesthesia techniques, which its usage has some benefits compared to general anesthesia.[1] The different methods are used in upper extremities for brachial plexus nerve block. Axillary approach, especially with ultrasound guidance and nerve locator due to its easiness, reliability, and

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safety, is the most common brachial plexus block method.[2,3]

Systemic opioids were used to reduce anxiety during surgery for many years. Pain reduction of opioids through central receptors and spinal cord is well-known. The peripheral effects of opioids and their mechanism of action have been studied recently, and they have been used as an adjunct drug in peripheral nerve blocks including axillary block.[4,5]

Since there is no agreement among the previous studies,[6,7] and given the fact that in previous studies only morphine and fentanyl with unequipotent doses have been used, this study was designed. In the current study, we investigated the effect of different opioids with equipotent doses adding to lidocaine in brachial plexus block with the axillary approach.

MATERIALS AND METHODS

After approval of University Research Committee (Research project no. 81064) and obtaining patients' informed consent, this double-blind randomized prospective clinical trial study was conducted through 2010–2013 in Al-Zahra Medical Center, Isfahan, Iran. The study population included the patients undergoing orthopedic surgery of the forearm and hand under ultrasound guided axillary block.

Inclusion criteria included American Society of Anesthesiologists physical statuses I or II, between 18 and 65 years of age. The patients having a history of alcohol or drug abuse, allergy to local anesthetic drugs, significant pulmonary, cardiovascular, renal, or hepatic diseases were not included. The patients in whom anesthesia method was changed (if the anesthesia was insufficient after forty minutes of local anesthetic administration), or it was impossible to follow them in the postoperative period were excluded.

The required sample size was calculated as n = 18 in each group using sample size estimation formula to compare the means and considering the assurance level of 95% and the test power of 80%. The standard deviation of pain in four cases was estimated 0.9, and the minimum significance difference between groups was considered 0.8.

The randomization of samples took place by using the random allocation software. In four study groups, a local anesthetic solution containing 40 mL of 1% lidocaine with epinephrine 1/200,000 concentration and opiates was injected. Adrenaline was used to improve the onset of action, to decrease drug uptake, and to prolong the action of the lidocaine.[8] The total volume used was 40 mL, which consists of 36 mL of lidocaine 1% +50 mcg of adrenaline in 2 mL sterile water (final concentration = 1/200,000) +2cc of diluted narcotic. The higher solution volume was used to provide adequate block in the setting of learning ultrasound program by residents.[9] Opiates used in each group were as follows:

Group M: 5 mg morphine, Group P: 50 mg pethidine, Group B: 0.2 mg buprenorphine, Group F: 75 mcg fentanyl. The mentioned doses were set based on equipotency of the drugs.[10] The volume of the opioid drug was reached to 2 mL in order to equalize the total volume in all four groups. For blinding the study, the anesthetist who recorded the data was unaware of the allocation of the study groups and was different from the anesthesiologist who performed the axillary block.

All patients underwent similar preoperative hydration and premedication protocol in all four groups. After prep and drape, in the supine position with the upper arm abducted at 90° neural plexus site was determined in the axillary region by using ultrasonography (S-Nerve Ultrasonography; Sonosite, Inc., USA) and nerve stimulator (NMS 300; Xavant Technology, Pretoria, South Africa). A skin wheal was produced using 1 mL of lidocaine 2% and then injection solution containing lidocaine, and one opiate was administered based on the study group using all in one injection technique. A nerve stimulator was helped to identify the axillary plexus. The needle position was considered as appropriate when an output current of 0.5 mA still elicited a distal motor response. If lower amplitudes elicited the motor response, it was considered that the needle has gone through the nerve fibers, and the solution was not administered into that site. Before the nerve block, adequate explanation about visual assay scale was given to all patients. The patient's vital signs including heart rate, systolic and diastolic blood pressures, SPO_2, and respiratory rate basically; and every 5 min after blockade for 15 min and then at 30-, 60-, 90-, 120-min were recorded in a questionnaire. Patients were considered sedated according to Ramsay sedation scale >2. The onset of sensory block was assessed by pinprick test and compared with the contralateral arm as reference. Motor blockade was evaluated using modified Bromage scale (0 = no motion, 1 = finger movement, 2 = wrist flexion, and 3 = elbow flexion). The duration of sensory and motor block was also recorded. The duration of sensory block was defined as the time interval between the local anesthetic administration and the complete recovery of anesthesia. Motor block duration was considered as the time interval between the administration of local anesthetic and the recovery of motor function.

The severity of patients' pain was measured at the onset of surgical incision, 1 h after the start of surgery, immediately after arrival to the recovery room and 6 and 24 h after surgery. All adverse effects caused by adding opiates (nausea, pruritus, bradycardia, hypotension) were recorded in the questionnaire. The survey data were entered into the computer and analyzed by using SPSS version 22 (IBM Corp., Armonk, NY) and appropriate tests including Chi-square test for qualitative variables, one-way ANOVA test for quantitative variables and repeated measures ANOVA for analysis of quantitative changes during intervention.

RESULTS

In this study, 72 patients were randomly divided into four equal (each 18) groups [Flow diagram 1]. There were no significant differences among the four groups based on demographic and basic variables including age, gender, weight, and the duration of surgery [Table 1].

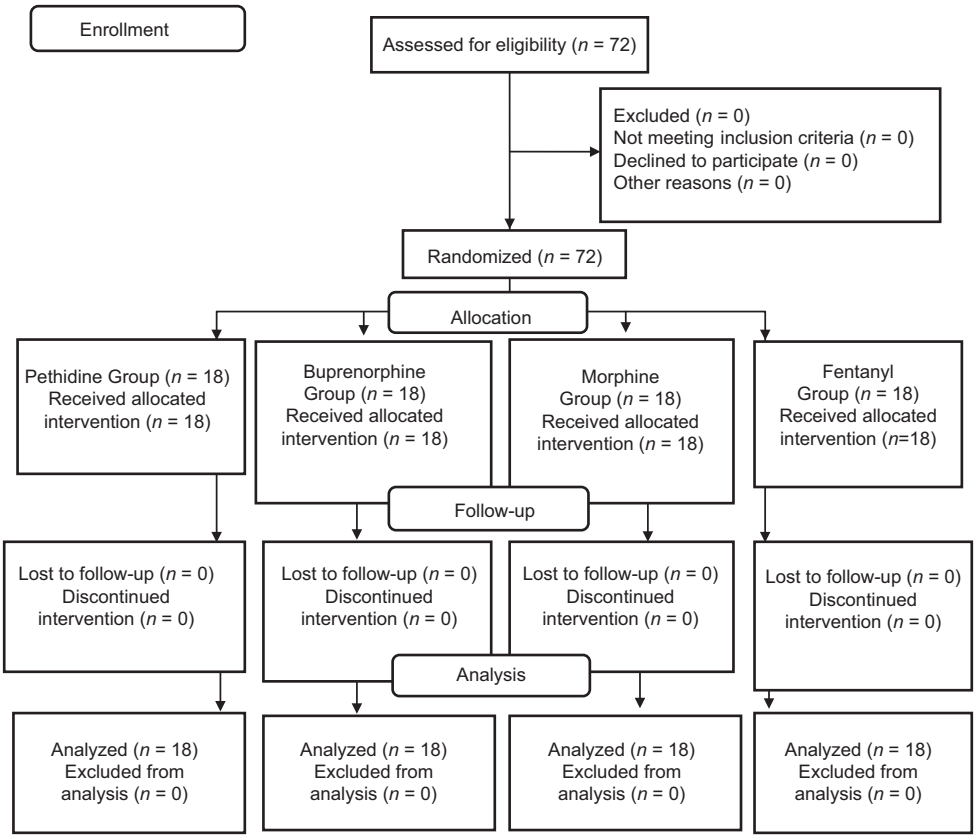
The hemodynamic parameter changes from the base to 90 min among the four groups are shown. Repeated measures ANOVA test on the data showed no significant differences among the four groups according to changes in mean heart rate, systolic blood pressure, diastolic blood pressure, SPO_2, and respiratory rate ($P > 0.05$). The mean time for sensory block onset was similar in for groups and based on one-way ANOVA test, no significant differences were observed among the four groups [Table 2]. The average time for onset of motor blockade was significantly shorter in morphine and pethidine groups based on one-way ANOVA and Scheffe tests ($P = 0.006$) [Table 2].

The duration of sensory and motor blockade was not statistically different among the four groups [Table 2]. The quality of motor blockade was complete in 100% of patients receiving pethidine or morphine and 77.8% of patients receiving buprenorphine or fentanyl ($P = 0.021$ based on Fisher's exact test) [Table 2].

The pain severity was evaluated during different times in the perioperative period. One-way ANOVA analysis showed the only significant difference among the four study groups at 24 h after surgery [Table 3]. However, repeated measures ANOVA showed that there was no significant difference based on pain severity changes among the four groups during the perioperative period ($P = 0.66$) [Table 3]. Not any patients developed signs of local anesthetic toxicity.

DISCUSSION

The overall objective of conducting this study was to determine the effect of adding different opioids with



Flow Diagram 1: Progress through the phases of this randomized trial

Table 1: Demographic and basic variables in the four study groups

Variable	Group				
	Pethidine	Buprenorphine	Morphine	Fentanyl	*P*
Age (year)	31.5±11.39*	28.83±8.51	32.89±14.92	30.72±11.62	0.3
Weight (kg)	72.87±12.27	69.94±7.79	73.28±6.5	68.33±9.24	0.33
Gender (male/female)	12/6	11/7	13/5	11/7	0.4
Duration of surgery (min)	86.47±17.12	92.34±21.34	88.23±19.14	95.32±18.41	0.71

*Data are expressed as mean±SD. Group pethidine: 50 mg pethidine, Group buprenorphine: 0.2 mg buprenorphine, Group morphine: 5 mg morphine, Group fentanyl: 75 mcg fentanyl, SD: Standard deviation

Table 2: Onset and duration of sensory and motor blocks in the four study groups

Variable	Group				
	Pethidine	Buprenorphine	Morphine	Fentanyl	*P*
Sensory block onset time	13.33±5.14*	13±2.59	11.67±3.43	11.11±4.04	0.28
Motor block onset time	21.67±4.54	28.06±3.04	23.44±9.08	26.78±4.95	0.006
Motor block duration	78.33±23.33	88.33±23.51	85±28.65	86.11±22.98	0.65
Sensory block duration	106.67±27.17	106.39±23.19	111.67±26.84	99.41±31.62	0.62
Motor block quality (complete/incomplete)	18/0	14/4	18/0	14/4	0.021

*Data are expressed as mean±SD of time (in min). Group pethidine: 50 mg pethidine, Group buprenorphine: 0.2 mg buprenorphine, Group morphine: 5 mg morphine, Group fentanyl: 75 mcg fentanyl, SD: Standard deviation

Table 3: Pain intensity according to VAS score during the perioperative period in the four study groups

Time	Group				
	Pethidine	Buprenorphine	Morphine	Fentanyl	*P*#
Beginning of the surgery	0.83±0.81*	1.22±1.1	0.39±0.78	0.78±0.88	0.07
1 h after surgery	0.44±1.52	0.5±0.62	0.22±0.55	0.33±0.59	0.48
At the recovery	0.67±0.69	0.61±0.7	0.61±0.61	0.39±0.7	0.47
6 h after surgery	1.28±0.83	0.77±0.65	1.67±1.37	1.39±0.98	0.65
24 h after surgery	1.89±0.9	1±0.91	2.5±2.46	1.39±1.04	0.021
P$	0.66				

*Data are expressed as mean±SD, #According to one-way ANOVA analysis, $Based on repeated measures ANOVA. Group pethidine: 50 mg pethidine, Group buprenorphine: 0.2 mg buprenorphine, Group morphine: 5 mg morphine, Group fentanyl: 75 mcg fentanyl, SD: Standard deviation, VAS: Visual assay scale

equipotent doses to lidocaine in brachial plexus block with an axillary approach using ultrasonography and nerve locator. The presence of opioid receptors on afferent nerve fibers has been identified; so many studies have been done to evaluate the peripheral analgesic effect of exogenous opioids used in nerve blocks either alone or in combination with local anesthetics.[11]

According to the results of monitoring, the hemodynamic and respiratory parameters during the anesthesia no significant differences were observed among the four groups in our study.

The onset time for the sensory block was similar in the four groups. However, the onset time for the motor block was significantly faster in morphine and pethidine groups. The duration of sensory and motor blocks was not statistically different among the four groups. The quality of motor blockade was more complete in patients receiving pethidine or morphine. This may be related to the local anesthetic-like action for pethidine. The authors have no any hypothesis about the mechanism of enhancement of motor block by morphine compared to other opioids.

Since in the upper extremity surgeries particularly such as carpal tunnel syndrome, any additional movement of the patient may cause serious injury, so much attention is paid on the complete motor block in surgeries. The pain severity changes were similar among the four groups during the perioperative period.

In the study of Fletcher *et al*., adding fentanyl to the anesthetic drug had no effect on the quality and the duration of sensory and motor nerve block and postoperative analgesia.[12] In the study of Karakaya *et al*., 60 patients undergoing brachial plexus anesthesia were divided into three groups, In this study, in first group bupivacaine 0.25%, in second group bupivacaine 0.25% plus fentanyl 2.5%, in third group bupivacaine 0.125% was used, in which the duration of motor block and analgesia was significantly greater in the group receiving bupivacaine + fentanyl.[13] Furthermore, in Nishikawa's study, adding fentanyl to anesthetic drug prolonged the analgesia time of patients after surgery.[14] In Bouaziz *et al*. study adding sufentanil to mepivacaine were evaluated, and no significant

improvement was observed in the quality of sensory and motor block and pain after surgery.[15]

It is necessary to state that the calculated sample size was relatively small in our survey, and this should be considered as a limitation of the study results. Another methodological weakness of our study is the absence of a control group receiving systemic opioid to consider central analgesic effects of absorbed opioids from the site of the axillary block.

Therefore, the overall conclusion from this study is that in the upper extremity surgeries, which are performed under local anesthesia, the addition of morphine or pethidine to local anesthetic drug due to better quality of motor block may be superior to other opioids (i.e., fentanyl or buprenorphine).

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Conflicts of interest
There are no conflicts of interest.

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