Research Letter

Ultrasound-guided erector spine plane block (ESPB) utilization in managing refractory renal colic pain in the emergency department

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Due to the acute and terrible pain that patients with renal colic experience, the most essential therapeutic priority for these patients in the emergency department (ED) is to reduce pain.[1] Although numerous medications are utilized to reduce pain in patients with acute renal colic, no therapy has yet been developed to totally and quickly relieve pain.[2,3] Intravenous opioids and nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly administered intravenously to control pain in these patients in the ED; however, the need for frequent monitoring for possible complications and relatively slow-acting features render these strategies undesirable.[4]

Erector spine plane block (ESPB) is one of the newest types of intra-fascial plane block in which an anesthetic substance is injected between the erector spine muscle and the transverse vertebral process under ultrasound guidance to block the dorsal and ventral branches of the thoracolumbar spinal nerve. ESPB block can be used to deliver regional analgesia, and is used to reduce chronic pain and acute pain in the ED.[5-8]

The present study was to compare the effectiveness of ultrasound-guided ESPB, as a complementary pain-controlling method, with that of intravenous fentanyl administration in patients with treatment-refractory renal colic. Moreover, complications and patient satisfaction levels were compared between the two methods.

METHODS

Study environment

This was a single-blinded clinical trial conducted on patients with renal colic refractory to ketorolac plus intravenous morphine sulfate administration (i.e., a pain score—numeric rating scale [NRS] above 8 despite receiving treatment).[9] The study was performed in the Department of Emergency Medicine, Kerman University of Medical Sciences, Kerman, Iran. These two EDs accept more than 135,000 patients each year.[10] Renal colic is treated with a mix of ketorolac and opioids at both sites, and the pain management approach is the same. The block randomization procedure was used to divide the patients into two groups after they had given their informed consent. Patients were randomly assigned to the fentanyl and ESPB groups using four blocks (each with two patients). This research employed a total of 10 blocks of four patients.

Ethical approval

This study was approved by the Ethics Committee of Kerman University of Medical Sciences (IR.KMU.AH.REC.1400.226.) and registered at the Iranian Registry of Clinical Trials (IRCT20220113053709N1).

Study population

All patients over 18 years of age with a diagnosis of treatment-refractory renal colic (after ruling out other causes of acute abdominal pain) referred during a one-year period (from December 1, 2020, to December 1, 2021) were included in the study. Individuals refusing to participate in the trial, those with a history of addiction, infection at the site of the block, a history of coagulopathy, sensitivity to lidocaine, NSAIDS, or narcotics, those with an acute abdomen, patients less than 18 years of age, or pregnant women were excluded.

Study protocols and procedures

A total of 40 patients with renal refractory colic who had

an NRS score above 8 despite receiving 60 mg ketorolac (30 mg/mL, Iran Hormone Co., Iran) plus 0.2 mg/kg intravenous morphine sulfate (10 mg/mL, Darou Pakhsh, Iran) were enrolled in the study. In the outpatient operating room, standard patient monitoring was performed, including continuous electrocardiogram (ECG) monitoring, pulse oximetry, and blood pressure measurement at least every 5 min. Access to an intravenous line was established, and resuscitation equipment, including vasopressors, drugs for local anesthetic toxicity, and intubating equipment, was maintained accessible. The first group of patients (n=20) was treated with fentanyl (50 μg/mL, Darou Pakhsh, Iran) at a starting dose of 1.5 μg/kg via slow intravenous injections. The second group of patients (n=20) received ESPB. After preparation, the patients were placed in the prone position. An ultrasound 7.5 MHz linear probe (DC-7 Mindray Ultrasound Machine, China) was placed at the longitudinal parasagittal orientation to the T8 vertebral level. The probe was then progressively pushed laterally toward the paravertebral area (3 cm from the midline) until the transverse process became apparent. The erector spine muscle should have been found superficial to the transverse process during verification of the transverse process. A 22G needle was inserted in the cephalad to caudal direction superior to the ultrasound probe using an in-plane technique. When the needle tip was below the erector spine muscle and after initial aspiration, to ensure that blood was not withdrawn, 1% lidocaine (4.5 mg/kg) was injected into the site. The erector spine muscle was visualized, separated from the transverse process.[11]

Pain intensity (the range of 0 to 10) was measured before the treatment and 30 and 60 min after the start of the treatment using the NRS. After 20 min of treatment, if minimally acceptable pain reduction was not achieved in either group (i.e., 2-point reduction compared to the baseline NRS score), the patient was infused with intravenous fentanyl (1 μg/kg) and then excluded from the study.[10] The block was completed under the direct supervision of an emergency medicine expert with the support of a resident in emergency medicine (PGY 3). The doctor completed a training course in ultrasound-guided nerve blocking at the Tehran University of Medical Sciences in 2014 and occasionally used this method for eight years. The data collection tool was a questionnaire into which all variables and outcomes were recorded.

Study variables and outcomes

The study variables included age, sex, pain level (baseline and 30 and 60 min after treatment), patient satisfaction, and treatment complications. As the primary outcomes of the study, NRS scores were recorded at 30- and 60-min post-blocking and compared between the two groups. Furthermore, treatment complications and patient satisfaction, as secondary outcomes, were compared between the two groups. Patient satisfaction was assessed using the standard Iowa questionnaire.

Sample size

According to the formula designed to compare two ratios, considering α=0.05 and β=0.2 (power=80%), and based on previous studies, the sample size was determined to be 20 per group.[12]

Statistical analysis

Qualitative indices were described by frequency percentages, and quantitative indices, which had normal distributions, were described by the mean±standard deviation. Analyses regarding sex and age were performed by the Chi-square test and Mann-Whitney U-test, respectively. The repeated measures ANOVA test was used to compare the NRS score between the two groups. The analysis of the interaction between the study group and time rendered a statistically significant outcome, indicating that the difference between the two groups in terms of the NRS score was time dependent. Thus, between-group and within-group comparisons of the NRS score at each time point (i.e., 30- and 60-min post-treatment) were made using Bonferroni correction. The Fisher's exact test was utilized to compare patient satisfaction and treatment complications between the two groups. A P-value <0.05 was regarded as statistically significant. SPSS 23 software (SPSS Inc., USA) was used for data analysis.

RESULTS

Out of 66 patients enrolled in the study, 26 were excluded. Finally, the data of a total of 40 patients were finally analyzed (Figure 1).

The mean age was 34.75±6.21 years in the fentanyl group and 38.20±6.85 years in the ESPB group. The mean NRS score was 8.55±1.27 in the fentanyl group and 8.60±1.09 in the ESPB group. There was no significant difference between the two groups in terms of age, gender, or NRS score at the beginning of the study (Table 1). However, the NRS score was significantly different between the fentanyl and ESPB groups after 30 and 60 min of treatment (P<0.01, Table 1). Moreover, comparisons within each group revealed a significant reduction in pain severity over time (P<0.01, Table 2). There was no significant difference between the two groups in terms of treatment complications (P=0.48). Only two cases of respiratory depression (10%) were observed in the fentanyl group. Finally, there was no significant difference between the two groups in terms of patient satisfaction (P=0.69).

DISCUSSION

Our research found that ESPB may significantly reduce discomfort in patients with refractory renal colic. This approach may be regarded as an alternative pain-relieving treatment in patients with refractory renal colic in the ED due to the absence of complications and probable patient satisfaction. As one of the newest local anesthetic blocks, ESPB was reported to be beneficial in the management of acute and chronic pain. Although its exact mechanism of action is unclear, it seems that ESPB can promote neural blockade and central inhibition from the direct spread of local anesthetic to the paravertebral space. Analgesia may also be induced by increasing the plasma concentrations of local anesthetics owing to systemic absorption, immunomodulation of local anesthetics, and activation of the mechanosensory characteristics of the thoracolumbar fascia. After being thoroughly distributed into neuronal spaces in the fascial plane to the erector spine muscles and neighboring tissues, ESPB may most likely produce local anesthesia principally and directly.[13,14] In EDs, ESPB is increasingly employed as a pain-relieving technique in patients with severe pain. Several studies have been conducted in this field; however, most of these studies are case reports and case series. Aydin et al[4] evaluated three patients with renal colic: the first patient with an NRS score of 10/10 was initially treated with fentanyl, but due to persistent pain, ESPB was performed, leading to a drop in the NRS score to zero; the second and third patients had NRS scores of 8/10 and 10/10, respectively, which both reduced to 2 after blocking. The findings of this research suggested that ESPB might be a good alternative to analgesics in individuals suffering from renal colic pain. Despite receiving high-dose acetaminophen, morphine sulfate, and fentanyl after 15 h of admission, a man with acute pancreatitis referred to the ED maintained an 8/10 pain level, according to Mantuani et al.[14] The patient subsequently underwent ESPB, which resulted in a pain score of zero after half an hour and a modest increase to 2/10 after 5 h. The analgesic effects of ESPB have also been reported in patients with traumatic back pain[15] and cancer-related abdominal pain[16] referred to the ED. In a 2020 clinical review by Abdelhamid et al,[17] ESPB was reported to be highly efficient in controlling the pain caused by rib-vertebrae fractures, burns, pancreatitis, herpes zoster infection, and renal colic in patients admitted to the ED. In conclusion, this technique seems to be a safe and easily applicable method for managing pain in EDs. Consistently, our findings revealed that ESPB could significantly relieve the pain associated with refractory renal colic.

To date, there have been no reports of ESPB causing any apparent side effects. Because the injection site is distant from the pleura, major blood arteries, and spinal cord, complications are uncommon. Complications included infections at the needle insertion site, local anesthetic toxicity, vascular puncture, pneumothorax, and failure block.[18] Hence, we observed no side effects for this procedure, which is in agreement with the meta-analysis conducted by Ma et al.[19]

ESPB was associated with desirable patient satisfaction,

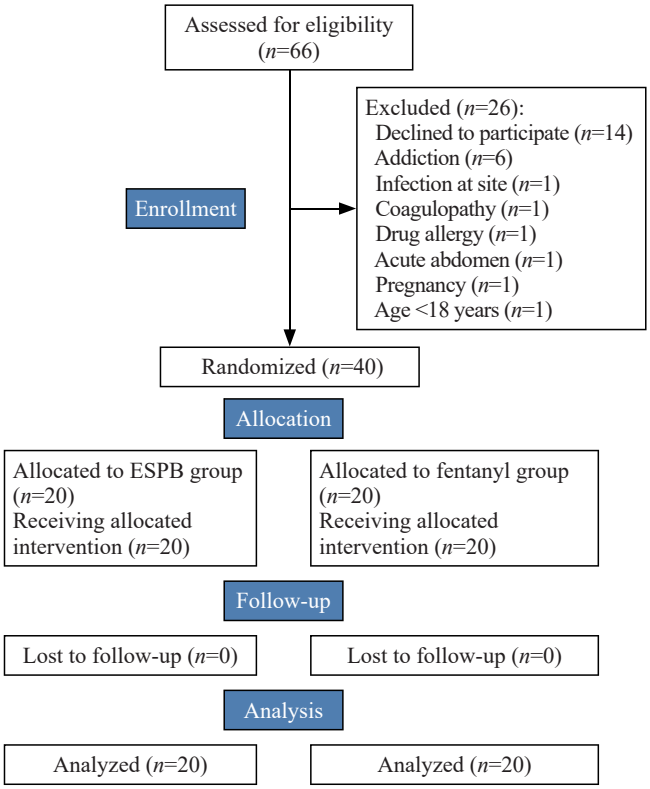

Figure 1. Consolidated standards of reporting trials flow diagram. ESPB: erector spine plane block.

Table 1. Comparison of basic characteristics and pain intensity changes in different time between ESPB and fentanyl groups

Variables	Fentanyl group	ESPB group	*P*-value
Age, years, mean±SD	34.75±6.21	38.20±6.85	0.92
Gender, *n* (%)			
Male	12 (60)	14 (70)	0.70
Female	8 (40)	6 (30)	
NRS, mean±SD			
Initial	8.55±1.27	8.60±1.09	0.59
NRS 30th min	3.25±1.60	1.30±1.03	<0.01
NRS 60th min	4.55±0.88	2.20±0.83	<0.01

ESPB: erector spine plane block; NRS: numeric rating scale.

Table 2. Pain intensity changes compared to prior time in ESPB and fentanyl groups

Groups	Comparison of NRS between time 1 and 2 (*P*-value)	Comparison of NRS between time 2 and 3 (*P*-value)	Comparison of NRS between time 1 and 3 (*P*-value)
Fentanyl group	<0.01	<0.01	<0.01
ESPB group	<0.01	<0.01	<0.01

ESPB: erector spine plane block; NRS: numeric rating scale.

which was in line with a previous study comparing this method with other therapeutic procedures.[20] All of our patients were satisfied with the effectiveness of this method in controlling the pain. Meanwhile, there was no significant difference between the fentanyl and ESPB groups in terms of patient satisfaction.

Limitations

The current study has certain limitations, such as the exclusion of some patients who refused to participate and the lack of an experienced emergency medicine expert on our research team. It was also a single-blinded study since a double-blinded experiment was not viable to construct. Finally, the patients were not followed up on for any potential long-term consequences; thus, our findings cannot be applied to other age groups.

CONCLUSIONS

Considering the effectiveness and safety of ESPB and the satisfactory levels of patient satisfaction, this method may be considered an alternative or complementary therapy to control pain in patients with refractory renal colic admitted to the ED.

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Ethical approval: The study was approved by the Ethics Committee of Kerman University of Medical Sciences (IR.KMU.AH.REC.1400.226.) and Iranian Registry of Clinical Trials (IRCT20220113053709N1).

Conflicts of interest: No potential conflict of interest was reported by the authors.

Contributors: MT proposed and wrote the paper. All authors read and approved the final version.

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