ORIGINAL INVESTIGATION

Is Jedi Grip efficient and effective in ultrasound-guided peripheral nerve blocking? A prospective, randomized, observer-blinded study

Neslihan Keklik [a], İsmail Aytaç [b,*], Semih Başkan [c], Betül Güven Aytaç [d]

a Afyonkarahisar Dinar State Hospital, Anesthesia Department, Afyonkarahisar, Turkey
b Ankara City Hospital, Anesthesiology Department, Ankara, Turkey
c Ankara City Hospital, Ankara Yıldırım Beyazıt University, Anesthesiology Department, Ankara, Turkey
d Ankara Etlik Zübeyde Hanım Obstetric and Gynecology State Hospital, Anesthesia Department, Ankara, Turkey

Abstract

Background: In this prospective, randomized, controlled observer-blinded study, we aimed to compare the efficacy of a single-operator technique called the Jedi Grip and a conventional technique requiring a double operator in ultrasound–guided axillary brachial plexus blocking.

Methods: Ninety-two patients (ASA I–II; aged 18–65 years old) who underwent elective hand, wrist and forearm surgery were randomly assigned to Group Conventional (C) or Group Jedi (J). In both groups, axillary plexus blockade was performed by applying 5 cc of a mixture of 10 cc of 0.5% bupivacaine and 10 cc of 2% prilocaine to the ulnar, radial, median, and musculocutaneous nerves. Parameters such as the performance time and number of needle passes were recorded during the procedure. Subsequently, a blinded observer evaluated and recorded parameters related to the blockade success. The main outcome variables were the performance time and success rate (surgical anesthesia).

Results: The block performance time of the Jedi technique was slightly longer than that of the conventional technique (220 (50), 202 (78) s, respectively) (*median (IQR)*; *p* = 0.05). No significant difference was found between groups in terms of blocking success; 9 (20%) from the conventional group and 3 (6.4%) from the Jedi group were unsuccessful (*p* = 0.053). No differences were found in terms of arterial puncture, and no other complications occurred in either group. The motor-sensory block onset and termination times and initial analgesia requirements were similar.

Conclusion: The Jedi technique may be applied safely with similar block success and performance results as the conventional technique.

© 2021 Sociedade Brasileira de Anestesiologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

* Corresponding author.
  E-mail: Ismail.Aytac1@saglik.gov.tr (İ. Aytaç).

Introduction

Ultrasound guidance has almost entirely changed and improved the practices of peripheral nerve blocks for the last two decades. However, ultrasound-guided block cannot eliminate complications such as accidental vascular injury, hemidiaphragm paralysis, and pneumothorax although it reduces these risks. Additionally, meta-analyses considering the relevant new literature cannot show evidence of reducing the incidence of peripheral neural injury.[1,2]

Ultrasound-guided regional anesthesia procedures are typically performed by two operators, one controlling both the ultrasound probe and peripheric block needle position, and the other assistant operator controlling the aspiration and injection of the local anesthetic (LA). Control of anesthetic injection is crucial to the success of the regional anesthesia. A disadvantage of this common habit is preventing the operator from perceiving the sense of resistance in the syringe plunger, indicating an intraneural needle tip position. Additionally, this technique requires an assistant who must have knowledge about the procedure and a good communication and coordination.[3,4] The absence or failure of the abovementioned elements might be a potential source of error while administering several small boluses as the needle tip is repositioned to optimize the spread of LA around nerves.

Several single-operator grip techniques of the needle and syringe for ultrasound (USG)-guided peripheral block have been described allowing the provider to perform independently to overcome the abovementioned situations, and these techniques have been criticized based on personal experience.[3–8] Although methods have been described in the literature, the classical method has not been compared with single-operator methods in any prospective, randomized controlled study. One of these techniques is called the Jedi Grip, defined by Pappin and Christie.[3] The peripheral block needle is held between the index finger and middle phalanx of the middle finger, and the syringe is held with fingers 4 and 5, with the plunger part to the thumb in the palm. The Jedi technique allows the operator to perform aspiration or injection by releasing the thumb.

In this study, we aimed to compare the Jedi technique and conventional peripheral block technique with an assistant in a prospective, randomized, controlled and observer-blinded study on patients who underwent elective hand, wrist and elbow surgery under axillary brachial plexus block in terms of various parameters including block success and the application time.

Methods

After obtaining ethics committee approval (SBU Ankara Numune SUAM Clinical Research Ethics Committee, numbered E-18-1955 and dated 25/04/2018) and written informed consent, this single-center, prospective, randomized, observer-blinded study was conducted between May 2018 and February 2019 at Ankara Numune Education and Research Hospital (Ankara). The trial was registered at Clinical Trials.gov (NCT04463329).

One hundred patients (aged between 18 and 65 years with American Society of Anesthesiologists [ASA] physical status I to II) undergoing elective hand, wrist and forearm surgery were prospectively enrolled. Eight patients were excluded from the study because of data loss. The inclusion criteria were age between 18 and 65 years, ASA I–II, and body mass index (BMI) between 18.5 and 35 kg.m^{-2}. The exclusion criteria of the study were as follows: hepatic or renal failure, serious cardiac or pulmonary disease, local or systemic infection, sepsis, coagulation disorder, neurological, muscular or psychiatric disease, body mass index (BMI) below 18.5 or above 35, drug and substance abuse, pregnancy, refusal of regional anesthesia, history of allergy to LA, mental-motor retardation (inability to consent or assess the visual analog scale [VAS] pain score), preoperative long-term nonsteroidal anti-inflammatory drugs (NSAID) or opioid use, and prior surgery in the axillary regions.

After creating 2 sets of 50 unique numbers from 1 to 100 for each group using an internet-based program (www.randomize.org), the patients were randomly allocated to one of the two groups as Group C (n = 50, conventional two-operator axillary brachial plexus blockade) and Group J (n = 50, axillary brachial plexus block with a single operator using Jedi grip).

A peripheral intravenous cannula (20–22G) was placed in the upper limb contralateral to the surgical site, and 1–2 mg of midazolam was administered before transferring to the operation room. Standard ASA monitoring was applied throughout the procedure, including the noninvasive arterial blood pressure, heart rate, and pulse oximetry. As a safety precaution, the anesthesia machine was tested, and general anesthesia drugs were prepared.

All the blocks were performed by the same researcher who practiced the Jedi technique before starting the study using polymer gel position pads by targeting a point with air injection and using the Jedi technique for almost 2 months in clinical practice before the study.

The same peripheral block needle and ultrasound machine were used for all the patients (a 22G, 5-cm long, short-beveled, teflon-coated needle (Locoplex; Vygon, France) and linear 38-mm, high-frequency 6 to 13 MHz transducer (Logiq e; General Electric, United States).

The patients in both groups were placed in the supine position, the arm was abducted 90 degrees on the side of the block, the elbow was flexed 90 degrees, and the head was turned to the shoulder side where the procedure was not performed. Skin disinfection was performed with povidone iodine and the patient was covered with a sterile drape. The 5 to 12 Millihertz linear USG probe (Logiq e, General Electric, USA) was covered with a sterile transparent sheath. A mixture of 10 cc of 0.5% bupivacaine and 10 cc of 0.2% prilocaine was prepared for a 20-cc syringe.

The axillary brachial plexus block was applied to patients either by the conventional two-person technique or one-person Jedi technique according to the allocated group. In Group C, the operator used the probe and needle with different hands while an assistant controlled the syringe to aspirate or inject LA. In Group J, a single operator controlled the probe with one hand while controlling the needle and syringe with the Jedi technique. The needle was held between the index finger and the middle phalanx of middle finger, and the syringe was held with fingers 4 and 5, with the plunger part to the thumb in the palm. Before the injection, the needle was absolutely aspirated to ensure that the

Figure 1   An example of the Jedi Grip performed at our hospital.

needle was not in the vein. Injection and aspiration were performed with thumb (Fig. 1A and B).

The procedure was the same in both groups except for the needle-holding technique. The ultrasound probe was positioned in the axilla at the lateral border of the pectoralis major muscle and perpendicular to the axis of the arm to obtain a short-axis view of the axillary artery and its surrounding nerve bundle. Image quality was optimized with the selection of the appropriate depth (within 2–3 cm), focus range (within 1 cm) and gain. The hyperechoic median, ulnar, and radial nerves were visualized around the axillary artery. With slight proximal-distal movement of the transducer, the musculocutaneous nerve or plane between the coracobrachialis and biceps muscles were visualized. After obtaining a satisfactory image, the imaging time (defined as the time interval between contact of the ultrasound probe with the patient to visualization) was recorded.

The needle was inserted in-plane from the anterior aspect and directed toward the posterior aspect. Nerves were separately imaged, and a 5-cc LA mixture was administered first to the radial, ulnar, median, and musculocutaneous nerves in all the patients. After the end of LA injection, the needling time (defined as the time between the entry of the needle through the skin to the end of local anesthesia) was recorded. The performance time was defined as the sum of the imaging and needling times. The number of needle passes and complications, such as paresthesia and vascular puncture, were also recorded.

After completion of the block, a single–blinded observer recorded the demographic data and questioned the patients about pain related to the block procedure using a 10-cm visual analog scale (0 cm = no pain, 10 cm = worst imaginable pain). The patients were also questioned for symptoms related to LA toxicity.

Subsequently, measurements of the brachial plexus blockade were performed every 5 minutes until 30 minutes by the same single–blinded observer.

Sensory blockade was evaluated and graded from the lateral side of the forearm, volar face of the thumb, volar face of the 5th finger and lateral side of the hand back for the musculocutaneous, median, ulnar, and radial nerves, respectively. Grading was performed according to a previously validated 3-point scale using a cold test: 0 = no block, 1 = analgesia (patient can feel touch, not cold), and 2 = anesthesia (patient cannot feel touch).[9–11]

Motor blockade was evaluated and graded with elbow flexion, thumb abduction, thumb opposition, and thumb adduction for the musculocutaneous, radial, median, and ulnar nerves, respectively. Motor blockade grading was also performed according to a (validated) 3-point scale: 0 = no block, 1 = paresis, and 2 = paralysis.[9,11]

Motor and sensory examinations were performed for all four nerves every five minutes, and the sum of the results was recorded as the composite score. The overall maximal composite score was 16 points. When the total composite score was a minimum of 14 or higher (with a sensory component of 7 or more), the patient was considered ready for surgery. The time until the composite score was 14/16 and above was defined as the anesthesia onset time, i.e., the time to reach surgical anesthesia.[8,10]

The sensory block onset time was defined as the time from the end of block application until the sensory block score was at least 1 point in any of the radial, ulnar, median, or musculocutaneous nerves. The motor block onset time was defined as the time from the end of block application until the motor block score was at least 1 point in any of the radial, ulnar, median, or musculocutaneous nerves.

After the operation, the time to at least one point of regression in the sensory block and first analgesic requirement was measured, and the severity of pain was assessed with VAS. Patient satisfaction was also evaluated using a 4-point Likert scale as follows: 4: excellent; 3: good; 2: fair; and 1: poor.

Statistical analysis

The number of patients required for each group was determined using the G-Power 3.1.9.4 package program. Anticipating a 1-minute difference in the needling time was significant, and the estimated sample size was 45 per group with d = 0.60 (effect size), α = 0.05 and power = 80%. We planned to conduct the study with 100 patients to ensure adequate final numbers.

Table 1 Characteristics of the patients.

Variables	Conventional (n = 45)	Jedi (n = 47)
Age (year), Mean $\pm$ SD	38.82 $\pm$ 12.29	33.47 $\pm$ 11.66
Height (cm), Mean $\pm$ SD	170.98 $\pm$ 8.30	171.66 $\pm$ 8.16
Weight (kg), Mean $\pm$ SD	77.66 $\pm$ 14.36	72.87 $\pm$ 11.19
BMI (kg.m^{-2})	26.52 $\pm$ 4.45	24.72 $\pm$ 3.65
Gender, n (%)		
Female	7 (15.6%)	9 (19.1%)
Male	38 (84.4%)	38 (80.9%)
Asa physical status, n (%)		
I	9 (20%)	13 (27.7%)
II	36 (80%)	34 (72.3%)

The IBM SPSS 20 statistical package program was used for data analysis. For all statistics, the significance limit was set at $p < 0.05$. Categorical data were expressed as absolute and relative frequencies. Continuous variables were expressed as means and standard deviation, when normally distributed, and as medians and quartiles or interquartile ranges for those without a normal distribution. The Shapiro-Wilk test was used to examine the compatibility of the data for normal distribution. Chi-squared test and Fisher's exact test were used to compare categorical variables between the two groups. Group comparisons of continuous data with a normal distribution were analyzed using t-test, and group comparisons of data did not show a normal distribution were analyzed using the Mann-Whitney U test.

Results

One hundred patients who underwent hand, wrist and forearm surgery were randomly assigned to 1 of 2 groups. Eight patients were excluded from the study because of incomplete data due to early discharge. Finally, 92 patients (Group C, n = 45; Group J, n = 47) were included in the study (Fig. 2).

The characteristics of patients are presented in Table 1. The weight, height, sex and ASA status were similar between groups ($p > 0.05$) but there was a statistically significant difference in age and body mass index (BMI) ($p < 0.05$) (Table 1).

The imaging times were similar between groups, but the needling and block performance times of the Jedi technique were slightly longer than those of the conventional technique ($p < 0.05$) (Table 2). No statistically significant difference was found between the two groups in terms of arterial puncture, number of needle entries, pain (VAS) during the procedure, block success or need for additional anesthesia ($p > 0.05$) (Table 3).

The onset times of sensory block, motor block and anesthesia were similar between the groups ($p > 0.05$). The sensory and motor block regression times were evaluated only in patients with successful block and were similar between groups ($p > 0.05$) (Table 3).

No statistically significant difference was found between the groups in terms of the postoperative VAS values (Group C 4.5 $\pm$ 2.08 and Group J 4.4 $\pm$ 2.16; $p = 0.478$). The postoperative VAS score was not assessed in patients with block failure.

No statistically significant difference was observed between the groups in terms of the time to first analgesia requirement. In both groups, the patients did not require analgesics for at least 10 hours after block (Group C: 10.72 $\pm$ 3.2 h, Group J: 10.61 $\pm$ 3.5 h; $p = 0.889$).

No statistically significant difference was found between the two groups in terms of patient satisfaction (Table 4). No differences were found in terms of arterial puncture, and no other complications occurred in either group during block and intraoperative or postoperative follow-up.

Discussion

Various single-operator ultrasound-guided peripheral block methods have been described in the literature.[3–8] These methods have been criticized based on personal experience.[7] However, to date, no prospective randomized controlled study has compared the classical two-operator method and single-operator methods.

Our results suggest that the Jedi technique achieves similar success rates with slightly longer block performance times than the conventional two-operator block technique. The anesthesia onset times were similar between groups.

Ultrasound guidance has been reported to reduce regional anesthesia-related complications.[1] In ultrasound-guided regional anesthesia, it is possible to determine the localization of the nerve and clearly observe the drug spread during the administration of LAs. Based on the relevant literature, it is reasonable to assume that the use of USG can lead to improvements in patient safety by reducing nerve damage, LA systemic toxicity (LAST), or other complications. However, the American Regional Anesthesia Association (ASRA) also states that the use of ultrasound does not reduce the incidence of regional neural injury associated with regional anesthesia.[1,2]

Although tactile pressure sensation in the injection piston is accepted as subjective data,[12,13] the use of various methods together would likely increase the safety level.

Conventionally, in ultrasound-guided peripheral nerve blocks, aspiration and injection are performed by an assis-

Table 2 Comparison of imaging, needling, and block performance times between groups.

Variables	Conventional (n = 45)	Jedi (n = 47)	Hodges Lehman estimate	95% CI Lower	Upper	*p*-value
Imaging time (s)^a	3 (1)	3 (2)	0	-1.00	0.00	0.081
Needling time (s)^a	202 (78)	220 (50)	-30	-50	-5	0.010
Block performance time (s)^a	205 (76)	227 (50)	-31	-52	-7	0.009

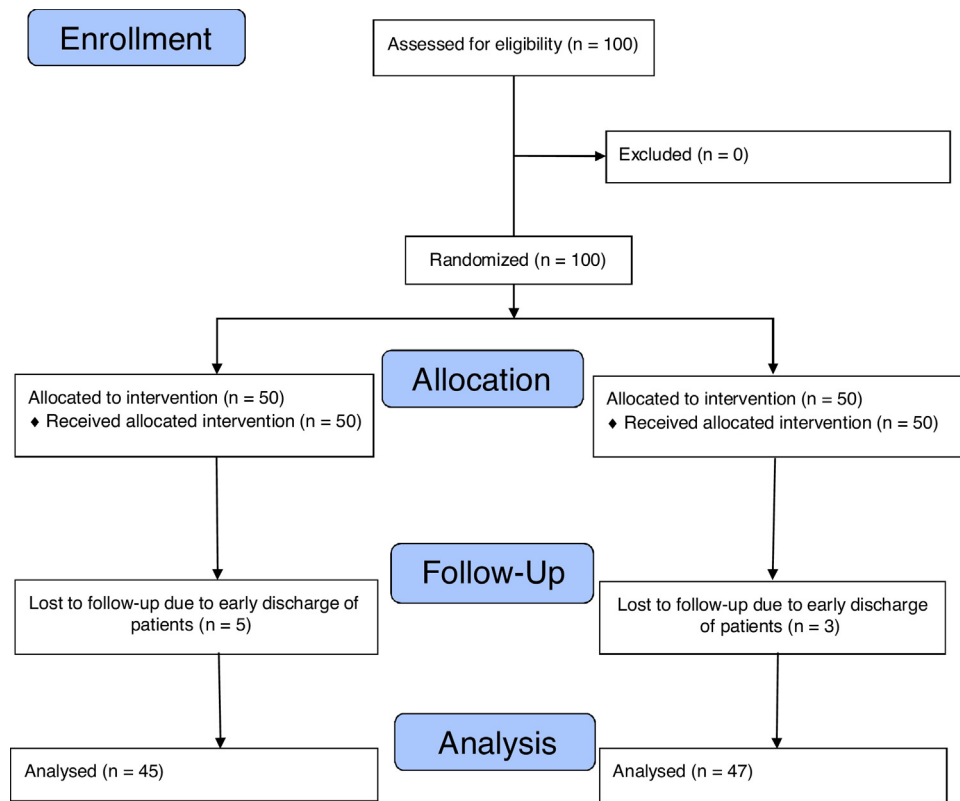^{a} The variable is expressed as median (IQR) and Mann-Whitney U test was used for comparison.

Figure 2 Flow chart of the study.

Table 3 Comparison of block characteristics and success between groups.

Block characteristics	Conventional (n = 45)	Jedi (n = 47)	p-value
Pain During Procedure (VAS)[a]	0 (1)	0 (1)	0.332
Number of Needle Entries, n (%)[b]			
1	44 (97.8%)	47 (100)	0.489
2	1 (2.2%)	0 (0)	
Arterial Puncture, n (%)[b]	6 (13.3%)	6 (12.8%)	0.936
Unsuccessful, n (%)[b]	9 (20%)	3 (6.4%)	0.053
Conversion to general anesthesia, n (%)[b]	9 (20%)	7 (14.9%)	0.518
Sensory block onset time (min)[a]	5 (0)	5 (0)	0.189
Motor block onset time (min)[a]	5 (5)	5 (5)	0.329
Anesthesia onset time (min)[a]	20 (4)	20 (5)	0.102
Sensory block regression time, n (%)[b]			
2–8 hours	27 (75%)	25 (56.8%)	0.090
8–18 hours	9 (25%)	19 (43.2%)	

[a] The variable is expressed as median (IQR) and Mann-Whitney U test was used for comparison.
[b] Chi-squared test or Fisher's exact test were used where appropriate.

tant while the anesthesiologist holds the USG probe in one hand and the peripheral block needle in the other. Singh et al.[14] reported the current practice among anesthesiologists from a closed Facebook group questionnaire. As expected, in this study, most of the participants used conventional techniques except for those using alternative single operator let-go techniques (17.3%). It can be assumed that the disadvantage of this technique is to drop the needle free at the injection stage without control.

Pappin and Christie[3] stated that the practitioner cannot sense the piston pressure of the syringe, indicating intraneural injection. They also indicated that smaller doses of bolus injections at different points around the nerve sheath are required to achieve LA spread in USG-guided blocks, leading to communication and coordination problems between the practitioner and assistant. They described the Jedi needle holding technique as a precaution against these problems. According to Pappin and Christie, the amount of LA injected can be reduced as the time and quantity of the injection

Table 4 Comparison of patient satisfaction between groups.

Variables	Conventional (n = 45)	Jedi (n = 47)	p-value
Patient satisfaction, n (%)			
Fair and poor	9 (20%)	3 (6.4%)	0.053
Good and excellent	36 (80%)	44 (93.6%)	

passes to the practitioner's control without the need for communication and coordination.[3,4]

The Jedi technique has been criticized based on personal experience because of the difficulty of using a 20-ml syringe and involuntary shift of the needle tip position during aspiration.[7] However, the justification of these criticisms in the literature has not been proven by prospective randomized controlled studies. The Jedi technique is the only single-operator technique that allows injection and aspiration without leaving control of the needle.

In this study, we aimed to compare the Jedi method described by Pappin[3] and the classical peripheral block method with an assistant in a prospective randomized and controlled study on patients who underwent axillary brachial plexus block in terms of various parameters, including block success and application time.

Thus, we found that the Jedi technique slightly increased the performance time. For all that, the Jedi technique did not increase the complications of arterial puncture, number of needle entries, or the patient's pain (VAS) during the procedure.

Sensory-motor block and the anesthesia onset time (time to reach surgical anesthesia) in the Jedi technique were not prolonged compared with those in the conventional technique.

The Jedi technique was found to be as efficient and effective as the classical method in terms of the block success rate.

The regression time of the sensory block, VAS values after the regression of the block, and time of the first analgesic requirement were similar. In both groups, patients did not require analgesics for at least 10 hours after the block. In both techniques, the patients' satisfaction with the procedure was similar. The Jedi technique did not increase the complication rate compared with the classical method.

Thus, one advantage of learning and the performing Jedi technique is that it provides the opportunity to perform regional anesthesia during working shifts with few and untrained staff.[15−17]

Several limitations of our study can be listed as follows. The operator was more experienced with the conventional technique. Therefore, before starting the study, the operator practiced the Jedi technique on gel pads for 2 months to minimize the difference in experience. The techniques should be compared with a large number of operators because, different operators' levels of success in both techniques may vary. Another limitation of the study was sample size insufficiency for interpreting complication rate because of the low expected occurrence of block complications and the calculation of sample size according to the block performing time.

Conclusions

The Jedi technique allows a single operator to perform peripheral nerve block by holding the syringe, peripheral block needle on one hand and ultrasound probe on the other hand. The technique excludes communication and coordination problems between the operator and assistant. It allows the operator to feel the applied pressure tactically in the piston, thereby achieving success rates similar to those of the conventional method. Studies are needed comparing the Jedi technique with other single-operator techniques and investigating whether the LA dose can be reduced with single-operator techniques.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Neal JM. Ultrasound-guided regional anesthesia and patient safety: update of an evidence-based analysis. Reg Anesth Pain Med. 2016;41:195−204.
2. Neal JM, Barrington MJ, Brull R, et al. The second ASRA practice advisory on neurologic complications associated with regional anesthesia and pain medicine: executive summary 2015. Reg Anesth Pain Med. 2015;40:401−30.
3. Pappin D, Christie I. The Jedi Grip: a novel technique for administering local anaesthetic in ultrasound-guided regional anaesthesia. Anaesthesia. 2011;66:845.
4. Christie I. Sensing injection pressure: the Jedi grip clarified. Anaesthesia. 2016;71:477.
5. Bedforth N, Townsley P, Maybin J, et al. Single-handed ultrasound-guided regional anaesthesia. Anaesthesia. 2011;66:846.
6. Gupta P, Berrill A. 'On lock'−a further single-operator ultrasound-guided regional anaesthesia grip. Anaesthesia. 2017;72:1289.
7. Biswas A, Ó Riain S. Jedi grip and single-handed ultrasound guided-regional anaesthesia. Anaesthesia. 2012;67:194.
8. Bedforth N, Townsley P, Maybin J, et al. Jedi grip and single-handed ultrasound guided-regional anaesthesia reply. Anaesthesia. 2012;67:194−5.
9. Tran DQ, Russo G, Muñoz L, et al. A prospective, randomized comparison between ultrasound-guided supraclavicular, infraclavicular, and axillary brachial plexus blocks. Reg Anesth Pain Med. 2009;34:366−71.
10. Tran DQ, Bertini P, Zaouter C, et al. A prospective, randomized comparison between single-and double-injection ultrasound-guided infraclavicular brachial plexus block. Reg Anesth Pain Med. 2010;35:16−21.
11. Tran DQ, Clemente A, Tran DQ, et al. A comparison between ultrasound-guided infraclavicular block using the ''double bubble'' sign and neurostimulation-guided axillary block. Anesth Anal. 2008;107:1075−8.
12. Adams A. Nerve block injection pressure monitoring. Anaesthesia. 2016;71:113−4.
13. Patil J, Ford S, Egeler C, et al. The effect of needle dimensions and infusion rates on injection pressures in regional anaesthesia needles: a bench-top study. Anaesthesia. 2015;70:183−9.
14. Singh SK, Mistry T. ''Let Go''technique in ultrasound guided Regional Anaesthesia. J Anaesth Crit Care Case Rep. 2019;5:7−9.

15. Kumar A, Gadsden J. Future Trends in Regional Anesthesia Techniques. In: Essentials of Regional Anesthesia. Springer; 2018. p. 695–703.

16. Lipton M, Ferre RM. Ultrasound Associated Materials and Equipment. In: Ultrasound Program Management. Springer; 2018. p. 225–41.

17. Lipnick MS, Dubowitz G, Wabule A. Regional anesthesia in resource-constrained environments. In: Atlas of Ultrasound-Guided Regional Anesthesia. Elsevier; 2019. p. 405–12.