Original Article

To determine block establishment time of supraclavicular brachial plexus block using blunt versus short bevel needle: A prospective randomized trial

ABSTRACT

Background: Unintentional intraneural injection under ultrasound guidance (USG) with fine caliber needles and lower success rate with large caliber Tuohy needles in supraclavicular brachial plexus block (SCB) have been reported.

Materials and Methods: We undertook study to standardize the use of 20-gauge short versus blunt bevel needle for SCB. After approval of Institutional Ethics Committee and written informed consent, patients were randomized using computer-generated random number table to either of the two groups; blunt bevel needle group (n = 30): SCB under USG using 20-gauge Tuohy needle or short bevel needle group (n = 30): SCB under USG using 20-gauge short bevel needle. The primary outcome of the study was time to establishment of sensory and motor block of individual nerves, and secondary outcome was tolerability and any adverse effects.

Results: The time to establishment of sensory and motor block in individual nerve territory was similar in both the groups. The complete sensory and motor anesthesia was achieved in 78.3% patients and complete sensory and motor anesthesia after supplementary block was achieved in 86.6% patients. Paresthesias during SCB were recorded in 15 patients. Out of these eight patients were of blunt bevel group and seven patients were of short bevel group. None of the patients experienced any neurological adverse effects.

Conclusion: The establishment of sensory and motor blockade of individual nerves was similar to 20-gauge short and blunt bevel needle under ultrasound guide with no neurological adverse events.

Key words: Needle; supraclavicular brachial plexus block; ultrasound guided; upper limb

Introduction

Ultrasound-guided supraclavicular brachial plexus blocks (SCBs) have increasingly been used for upper limb surgeries for higher block success rate and negligible incidence of pneumothorax in comparison to the blind technique.[1,2] Intraneural placement of an injectate had been a problem and can be visualized under ultrasound guidance (USG) as an immediate change in nerve morphology.[3,4] Direct trauma to plexus nerves, intraneural placement of drugs and its attendant neurological complications have been reported with sharp beveled needles even under USG.[5-7] To address the issue of nerve injury and intraneural injections, Fredrickson *et al*.[8] used an 18-gauge Tuohy needle for supra and infraclavicular blocks. Though there were no long-term

Access this article online	
Website: www.saudija.org	Quick Response Code
DOI: 10.4103/1658-354X.174910	

How to cite this article: Ahuja V, Thapa D, Gombar S, Dhiman D. To determine block establishment time of supraclavicular brachial plexus block using blunt versus short bevel needle: A prospective randomized trial. Saudi J Anaesth 2016;10:259-64.

Ahuja V, Thapa D, Gombar S, Dhiman D

Department of Anesthesia and Intensive Care, Government Medical College and Hospital, Chandigarh, India

Address for correspondence: Dr. Vanita Ahuja, Department of Anesthesia and Intensive Care, Government Medical College and Hospital, Sector 32, Chandigarh, India. E-mail: vanitaanupam@yahoo.co.in

neural injury in that study the block quality degraded and the reasons were attributed to use of wider gauge Tuohy needle. There is no clear consensus regarding optimal configuration of needle required with regard to its caliber, type for SCB and its clinical implication postoperatively.

In the present study, we hypothesized that reducing Tuohy needle caliber to 20-gauge for SCB could be beneficial in improving block quality while simultaneously retaining the advantage of atraumatic blunt tip. Hence, the present study was aimed to evaluate and compare time to establishment of sensory and motor SCB with 20-gauge blunt versus short bevel needle under USG for patients undergoing upper limb surgeries.

Materials and Methods

We undertook this prospective, randomized clinical trial to evaluate the onset time of sensory and motor block of individual nerves in SCB under USG. The study was conceived in accordance with the Declaration of Helsinki and its amendments. The study protocol was approved by the Hospital Institutional Ethics Committee (GMC/TA-I (19)/2011/20317) and registered with Clinical Trials Registry India (CTRI/2011/07/001876). Written informed consent was obtained from all subjects recruited during June 2011 to March 2015. The design and conduct of the trial adhered to the CONSORT statement. Inclusion criteria were patients of ASA physical status 1-2, aged between 18 and 60 years scheduled for upper limb surgeries. Exclusion criteria was patients with neuropathy involving the arm undergoing surgery, mental incapacity, body mass index >35 kg/m^2, known allergy to local anesthetics, local infection, coagulopathy, and any other contraindication to peripheral nerve blocks.

The patients were evaluated a day prior to surgery, and all routine and required investigations were done. All patients fasted for 8 h prior to surgery and were premedicated with pantaprazole 40 mg and alprazolam 0.25 mg per oral at night and 2 h prior to surgery. On arrival of patient in the operating room intravenous (IV) access was secured and standard anesthesia monitoring (Aestiva 5™ 7900, GE healthcare, Datex-Ohmeda division, Helsinki, Finland) including noninvasive blood pressure, heart rate, oxygen saturation and electrocardiographic monitoring were started and recorded every 5 min.

The patients were placed in supine position with the head turned 45° to opposite side of the surgery. A single operator anesthesiologist (VA) experienced in ultrasound performed all the SCBs. Under strict asepsis, the supraclavicular area of the side to be operated was cleaned and draped. The ultrasound probe (8-15 MHz Sono Site® Titan, Washington, USA) was placed in coronal oblique plane in supraclavicular fossa to visualize subclavian artery and brachial plexus. The brachial plexus appeared as a cluster of hyperechoic nodules usually found lateral to the round pulsating subclavian artery lying on the top of the hyperechoic first rib.

Allocation concealment was done with opaque sealed envelopes. Patients were randomized using computer-generated random number table, and the envelope was opened immediately before block placement by an anesthesiologist who was not involved in the study and assessment of patients. The patient and the assessor were blinded to the group allocation. Local anesthesia with 2 ml of 2% lignocaine was given subcutaneously in all the patients for insertion of block needle. The patients received SCB under USG with needle using in plane technique (to facilitate visualization of spread of local anesthetic and direction of block needle in real time and at the same time avoiding inadvertent vessel and pleural injury) as per group allocation to either of the two groups.

Blunt bevel needle group (n = 30): SCB under USG using 20-gauge Tuohy needle (BD Medical, 1 Becton Drive, Franklin Lakes, NJ 07417, USA).

Short bevel needle group (n = 30): SCB under USG using short bevel needle 20-gauge (150 mm) insulated needle with extension set (B. Braun Medical Inc., Bethlehem, PA, USA).

Ultrasound probe was placed inside a sterile cover, and needle movement was observed in the real-time. The tip of the needle was positioned at the junction of first rib and artery under USG and normal saline 2 ml was injected to confirm the spread around the plexus. In an event of any paresthesias, the needle was repositioned, and care was taken to avoid intraneural injection. If the local anesthetic spread did not reach some parts of brachial plexus, the needle was repositioned. A mixture of local anesthetic (1: 2 mixture of lignocaine 2% with 1:200,000 adrenaline and bupivacaine 0.5%) at a dose 0.5 ml/kg up to a maximum of 40 ml was given in increments of 3-5 ml every minute carefully after negative aspiration. The maximum dose of lignocaine with adrenaline was 7 mg/kg and 2 mg/kg for bupivacaine.

Outcome measures

1. Performance time was scanning time + needle time. If time required to visualize the anatomy and placement of block was >20 min then, the procedure was abandoned,

and the block was considered a failure.

2. Scanning time was recorded from the time ultrasound probe was placed on skin until a satisfactory image was obtained.
3. Needle time was taken from the time blunt or short bevel needle tip penetrated the skin and exited after block placement.
4. Immediately after block placement an observer blinded to group allocation asked the following questions.
   a. How will you rate your discomfort during the block on a scale of 0-10? If zero was no discomfort and 10 was the worst discomfort imaginable.
   b. Did you experience an electric shock like sensation in the arm during the procedure? Yes/No. The same observer then assessed sensory and motor block.
5. Sensory block was graded as 2 = Normal, 1 = Reduced and 0 = Absent to pinprick (26-gauge needle) sensation relative to the contralateral arm every 5 min for up to the time the grade = 0 occurred in all the nerve territories or up to a maximum of 60 min had elapsed. Musculocutaneous nerve = Lateral side of forearm, radial nerve = Dorsum of the hand over the second metacarpophalangeal joint, median nerve = Thenar eminence, ulnar nerve = Hypothenar eminence, medial cutaneous nerve of arm = Medial side of the arm and medial cutaneous nerve of forearm = Medial side of the forearm.
6. Motor block: Block was scored as 2 = Normal, 1 = Reduced, 0 = Unable to overcome gravity relative to the contralateral arm that was recorded every 5 min for up to the time the grade = 0 occurred in all the territories or up to a maximum of 60 min. Radial nerve = Push the arm by extending the forearm at the elbow against the resistance, musculocutaneous nerve = Resisting the pull of the forearm at the elbow, median nerve = Thumb and second digit pinch, ulnar nerve = Thumb and fifth digit pinch.
7. Surgical anesthesia success was considered as the performance of surgery without the requirement of block or general anesthesia (GA) supplementation. If block did not occur in one nerve territory, then block supplementation and surgical wound infiltration was done and recorded. If required, patients received propofol infusion 50-100 μ*g/kg/h* for intraoperative sedation.
8. Block failure was defined as partial or absent nerve block in more than one nerve territory. These patients received GA. The principal investigator recorded the requirement for block supplementation, surgical wound infiltration, patient request for sedation and conversion to GA.
9. Tourniquet time was observed.
10. A postblock radiograph in full exhalation was obtained if a patient complained of respiratory distress. After 24 h an anesthesia resident blinded to treatment group contacted the patients and asked when was the first oral analgesic taken and on postoperative day 10 regarding any neurological symptoms like numbness, tingling or altered sensation in the upper extremity or any other adverse effects until it resolved.

Statistical analysis

Assuming that the establishment of sensory and motor block occurred in 30 min and a standard deviation (SD) of 7 min with an α of 0.05, and a power of 80%, it was calculated that a sample size of 30 patients per group would be required to show a difference of 5 min for establishment of successful surgical block.[8] This sample size could also detect a 30% reduction in block success assuming a control block success of 70%. Data was analyzed using statistical software International Business Machines Corporation (IBM) SPSS Statistics (version 22.0) and expressed as mean ± SD or median with interquartile range as applicable. Student's *t*-test or the Fisher's exact test for 2 × 2 contingency tables used for statistical comparisons. Procedure related time and pain scores were analyzed using Mann–Whitney U-test, $P < 0.05$ was considered statistically significant.

Results

During June 2011 and March 2015, 70 patients were screened, of these 10 patients did not fit the inclusion criteria. Hence, 60 patients were randomized to either of the two groups, and all the patients completed the study [Figure 1]. The patient and clinical characteristics for each group showed no significant difference between the groups as shown in Table 1. The surgeries performed under SCB were similar in both the groups. The needle time was shorter in short bevel group due to superior visualization as compared to blunt bevel needle under USG, but the performance time was similar in both the groups as shown in Table 2. The time to establishment of sensory block and motor block in individual nerve territory was similar in both the groups as shown in Tables 3 and 4. Patients requiring conversion to GA were similar in both the groups. The patients requiring supplementary block were higher in ulnar and median nerve territory as compared to other nerve territories in both the groups as shown in Table 5. The complete sensory and motor anesthesia was achieved in 78.3% patients and complete sensory and motor anesthesia after supplementary block in 86.6% (eight patients required GA). Electric shock like sensation during block placement was recorded in 15 patients. Of these, eight patients were of blunt bevel group and seven patients were of short bevel group. Of 15 patients, one patient (short bevel group) received GA due to incomplete block, two patients required

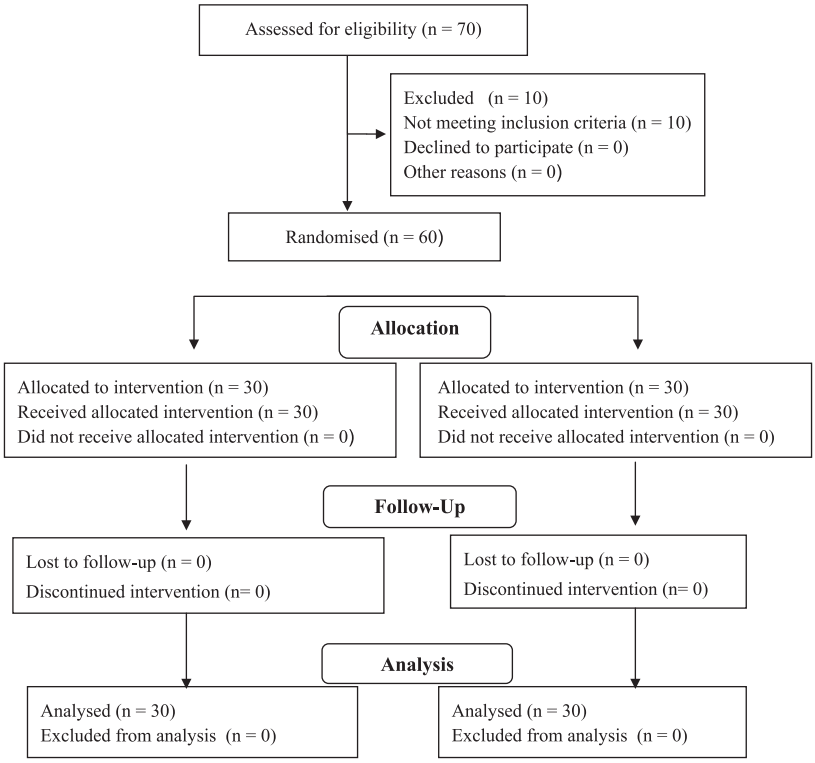

Figure 1: CONSORT diagram of patient distribution

Table 1: Baseline clinical characteristic of patients

Variables	Blunt bevel (*n* = 30)	Short bevel (*n* = 30)	*P*
Age (years)	42.1 (13.5)	36.2 (16.7)	0.14
Sex (male)	26	20	0.12
Weight (kg)	68.1 (13.6)	68.2 (15.7)	0.97
ASA I/II	24/6	26/4	0.73

Data represented as mean ± SD (IQR [range]) or *n*: Number, $P < 0.05$ considered statistically significant. SD: Standard deviation; ASA: American society of anesthesiologists; IQR: Interquartile range

supplementary block (one patient of blunt bevel and short bevel group each) and 12 patients attained complete surgical block. None of the patients has any hemodynamic instability in the perioperative period. No neurological adverse effects were reported on day 10 of follow-up.

Discussion

The major finding of the present study was similar time to establishment of sensory and motor blockade in SCB, when performed with 20-gauge blunt or short bevel needles in patients undergoing upper limb surgeries. According to literature, the choice of needle has an important role in onset of sensory-motor block and intraneural peripheral nerve injuries.[9,10] Long-bevel needles were known to produce more fascicular injuries as they probably impaled the nerves.[11,12] We used 20-gauge short bevel versus blunt bevel needles and did not include long-bevel needle as comparator group as it would have been unethical due to evidence of harm described in the literature.[11] The nerve trauma has a direct relation on the diameter of the needle used in the "intentional nerve" injury.[13] The rational given by Fredrickson *et al*. of using an 18-gauge needle in their study was, that use of a larger diameter needle would avoid penetration of the needle into the peineural neurovascular sheath when performed under USG. The literature reports no evidence of intraneural injection with an 18-gauge needle.[6] Combining the evidences from these studies we kept our needle choice as a 20-gauge short bevel needle to overcome the failure rate as evidenced by use of 18-gauge Tuohy's needle and also to avoid any inadvertent intraneural injection which may occur by a fine bore needle long-bevel needle. Fredrickson *et al*. reported lower success rate of 57% SCB and the possible causes attributed to it were reduced local anesthetic volume (25-30 ml), large caliber needle and more likely nonutilization of neuro stimulation. A significant neurological nerve injury was observed in one patient in supraclavicular group, but the patient did not require any electrophysiological evaluation.[8] In the present study, the higher surgical success rate was attributed to correct placement of tip of the needle confirmed on USG as uniform spread of local anesthetic that bathed the brachial plexus. The mean local anesthetic volume used in the present study was 35 ml (0.5 ml/kg) which was slightly higher than the earlier study[8] but does not seem to be the only cause of higher success of surgical block in our study.

Table 2: Block characteristics of patients

Time (min)	Blunt bevel (n = 30)		Short bevel (n = 30)		P
	Mean (SD)	IQR (range)	Mean (SD)	IQR (range)	
Tourniquet time	77.1 (20.7)	61.5-90 (40-120)	77 (28.3)	59-100 (34-120)	0.7
Ultrasound scanning time	3.2 (6.72)	0.31-2 (0.2-30)	4.8 (8)	0.8-5 (0.16-30)	0.07
Needle time	8.2 (15.8)	4-6 (1-90)	4.1 (1.7)	3-5.3 (1-8)	0.03*
Performance time	9 (6.3)	5-9.8 (2-30)	7.5 (2.2)	6-9.3 (4-12)	0.83
First oral analgesic	49 (156.1)	360-600 (210-720)	584 (204)	420-720 (240-1200)	0.11

Data represented as mean (SD), IQR (range), *P < 0.05 considered statistically significant. SD: Standard deviation; IQR: Interquartile range

Table 3: Sensory block establishment time (min) in different nerve territories

Nerve	Blunt bevel (n = 30)		Short bevel (n = 30)		P
	Mean (SD)	IQR (range)	Mean (SD)	IQR (range)	
Median nerve	14.5 (9.8)	10-20 (5-50)	14.6 (8.9)	10-20 (5-45)	0.80
Ulnar nerve	16.3 (13.6)	5-20 (5-60)	14.3 (8.3)	10-20 (5-35)	0.97
Radial nerve	12.5 (10.6)	5-15 (5-50)	14.7 (12.3)	5-20 (5-60)	0.36
Musculocutaneous nerve	14.7 (10.9)	5-20 (5-50)	14.7 (12.2)	5-20 (5-60)	0.82
Medial cutaneous nerve of arm	16.5 (15.6)	5-21.25 (5-60)	13.5 (8.6)	5-16.25 (5-35)	0.91
Medial cutaneous nerve forearm	13 (10.9)	5-15 (5-50)	15.5 (12.3)	5-20 (5-60)	0.33

Data represented as mean (SD), IQR (range), P < 0.05 considered statistically significant. SD: Standard deviation; IQR: Interquartile range

Table 4: Motor block establishment time (min) in different nerve (n) territories

Nerve	Blunt bevel (n = 30)		Short bevel (n = 30)		P
	Mean (SD)	IQR (range)	Mean (SD)	IQR (range)	
Median nerve	23.7 (17.5)	10-31.3 (5-60)	20.3 (15)	10-25 (5-60)	0.48
Ulnar nerve	20 (17.1)	5-30 (5-60)	19.7 (15)	10-25 (5-60)	0.74
Radial nerve	16.8 (14.6)	5-20 (5-60)	15.3 (13.3)	5-16.3 (5-60)	0.78
Musculocutaneous nerve	22.5 (17.8)	10-31.3 (5-60)	20.17 (18.3)	5-20 (5-60)	0.45

Data represented as mean (SD), IQR (range), P < 0.05 considered statistically significant. SD: Standard deviation; IQR: Interquartile range

The literature suggests that time, quality and duration of block was not be improved only by arbitrarily increasing drug mass or its determinants, volume and concentration.[14]

Higher neurological complications occur in proximal brachial plexus block due to direct nerve trauma (1-6%)[15] and reduced nonneural tissue.[14,16] Block placement under USG with a smaller gauge blunt tip block needle can still result in an unintentional intraneural injection occurred in 17% of patients. Intraneural placement on USG is shown as an increase in nerve area >15%, echo-lucent areas within the nerve and visualization of the needle tip indentating and penetrating the nerve wall.[3,4] Neurological dysfunction is influenced with factors, such as obesity, neurologic and metabolic diseases, neurotoxicity, mechanical and ischemic injury, may contribute to the development of acute and/or chronic nerve damage. These patients were not enrolled in the present study. Elicitation of paresthesia during regional techniques is not linked to anesthesia related nerve injury but rather it is the pain on injection that is more consistently linked to injury.[17,18] Patients were asked to report painful injections suggestive of intrafascicular injection and injury

Table 5: Block failure at 60 min

Nerve	Blunt bevel (n = 30)	Short bevel (n = 30)	P
Supplementary block required for surgical anesthesia (n)	2	3	1.00
Axillary nerve block	2	1	
Ulnar nerve block	0	1	
Medial cutaneous nerve of arm	0	1	
Partial sparing sensory block			
Median nerve	2	0	
Ulnar nerve	0	2	
Medial cutaneous nerve of arm	0	1	
Medial cutaneous nerve of forearm	0	1	
Partial sparing motor block			
Median nerve	2	2	
Ulnar nerve	0	1	
Required conversion to GA (n)	4	4	1.00
Surgical anesthesia incomplete	2	1	
Medial cutaneous nerve of arm	1	0	
Median nerve	2	1	
Ulnar nerve	2	1	
Surgery at other site or bone grafting	2	3	

Data represented as n: Number. P < 0.05 considered statistically significant. GA: General anesthesia

that would prompt repositioning of the needle. However, we did not use any device for pressure measurement to detect high intraneural injection pressure and relied on the pressure by the syringe's feel, which can be at times variable.

Surprisingly, one patient in the present study had complete motor block but reported partial sensory block in the medial cutaneous nerve of arm and required GA. Partial or no nerve block was observed in (2/30 patients) in ulnar and (4/30 patients) in median nerve territories in blunt bevel needle in the present study. In an earlier study ulnar (11/30 patients) and median (4/30 patients) nerves had partial or no block with 18-gauge Touhy needle for placement of SCB. This probably occurred due to corner pocket technique used by the authors.[8] The sparing of ulnar and median nerves usually occurs due to nonplacement of needle tip near the lower trunk that is close to first rib due to risk of pneumothorax. An earlier study showed superior results with stimulation of lower trunk of SCB.[19]

The limitation of the study was nonutilization of pressure manometer during injection of local anesthetics and patients were followed only till 10 days postoperatively. Further multicenter trials are required to validate the results of this study.

Conclusion

The time to establishment of sensory and motor blockade in SCB performed with either 20-gauge short or blunt bevel needle under USG were similar, in patients undergoing upper limb surgeries with no significant neurological adverse effects.

Acknowledgment

We would like to thank Palak gupta for data compilation.

Financial support and sponsorship

Department of Science and Technology, Chandigarh, India.

Conflicts of interest

There are no conflicts of interest.

References

1. Franco CD, Vieira ZE. 1,001 subclavian perivascular brachial plexus blocks: Success with a nerve stimulator. Reg Anesth Pain Med 2000;25:41-6.
2. Wedel DJ. Nerve blocks. In: Miller RD, editor. Millar's Anesthesia. 5th ed. Philadelphia, Pennsylvania: Churchill Livingstone; 2000. p. 1520-48.
3. Morau D, Levy F, Bringuier S, Biboulet P, Choquet O, Kassim M, *et al.* Ultrasound-guided evaluation of the local anesthetic spread parameters required for a rapid surgical popliteal sciatic nerve block. Reg Anesth Pain Med 2010;35:559-64.
4. Liu SS, YaDeau JT, Shaw PM, Wilfred S, Shetty T, Gordon M. Incidence of unintentional intraneural injection and postoperative neurological complications with ultrasound-guided interscalene and supraclavicular nerve blocks. Anesthesia 2011;66:168-74.
5. Kapral S, Krafft P, Eibenberger K, Fitzgerald R, Gosch M, Weinstabl C. Ultrasound-guided supraclavicular approach for regional anesthesia of the brachial plexus. Anesth Analg 1994;78:507-13.
6. Dingemans E, Williams SR, Arcand G, Chouinard P, Harris P, Ruel M, *et al.* Neurostimulation in ultrasound-guided infraclavicular block: A prospective randomized trial. Anesth Analg 2007;104:1275-80.
7. Neal JM, Gerancher JC, Hebl JR, Ilfeld BM, McCartney CJ, Franco CD, *et al.* Upper extremity regional anesthesia: Essentials of our current understanding, 2008. Reg Anesth Pain Med 2009;34:134-70.
8. Fredrickson MJ, Patel A, Young S, Chinchanwala S. Speed of onset of 'corner pocket supraclavicular' and infraclavicular ultrasound guided brachial plexus block: A randomised observer-blinded comparison. Anesthesia 2009;64:738-44.
9. Jeng CL, Torrillo TM, Rosenblatt MA. Complications of peripheral nerve blocks. Br J Anesth 2010;105 Suppl 1:i97-107.
10. Selander D, Dhunér KG, Lundborg G. Peripheral nerve injury due to injection needles used for regional anesthesia. An experimental study of the acute effects of needle point trauma. Acta Anesthesiol Scand 1977;21:182-8.
11. Macías G, Razza F, Peretti GM, Papini Zorli I. Nervous lesions as neurologic complications in regional anesthesiologic block: An experimental model. Chir Organi Mov 2000;85:265-71.
12. Steinfeldt T, Nimphius W, Werner T, Vassiliou T, Kill C, Karakas E, *et al.* Nerve injury by needle nerve perforation in regional anesthesia: Does size matter? Br J Anesth 2010;104:245-53.
13. Bigeleisen PE, Moayeri N, Groen GJ. Extraneural versus intraneural stimulation thresholds during ultrasound-guided supraclavicular block. Anesthesiology 2009;110:1235-43.
14. Moayeri N, Bigeleisen PE, Groen GJ. Quantitative architecture of the brachial plexus and surrounding compartments, and their possible significance for plexus blocks. Anesthesiology 2008;108:299-304.
15. Brull R, McCartney CJ, Chan VW, El-Beheiry H. Neurological complications after regional anesthesia: Contemporary estimates of risk. Anesth Analg 2007;104:965-74.
16. van Geffen GJ, Moayeri N, Bruhn J, Scheffer GJ, Chan VW, Groen GJ. Correlation between ultrasound imaging, cross-sectional anatomy, and histology of the brachial plexus: A review. Reg Anesth Pain Med 2009;34:490-7.
17. Neal JM, Bernards CM, Hadzic A, Hebl JR, Hogan QH, Horlocker TT, *et al.* ASRA practice advisory on neurologic complications in regional anesthesia and pain medicine. Reg Anesth Pain Med 2008;33:404-15.
18. Schafhalter-Zoppoth I, Zeitz ID, Gray AT. Inadvertent femoral nerve impalement and intraneural injection visualized by ultrasound. Anesth Analg 2004;99:627-8.
19. Marhofer P, Sitzwohl C, Greher M, Kapral S. Ultrasound guidance for infraclavicular brachial plexus anesthesia in children. Anesthesia 2004;59:642-6.