ORIGINAL RESEARCH

Comparison between ultrasound guided supraclavicular and infraclavicular brachial plexus block to assess the quality of surgical anaesthesia and intraoperative tourniquet pain: prospective randomized observer blinded study

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Received: 12March, 2023 Accepted: 18April, 2023

ABSTRACT

Introduction: Of the various modalities of achieving surgical anaesthesia of the forearm, brachial plexus block by injecting local anaesthetic is considered highly beneficial and practical. Supraclavicular and infra-clavicular approaches of brachial plexus blocks provide comprehensive anaesthesia for surgeries of the forearm. The primary outcome measured was the comparison of two blocks with respect to sparing of any dermatome, whereas the secondary outcomes measured were block performance time, duration of analgesia, and complications associated with each technique.

Materials & Methods: 60 adult patients of either sex belonging to the American Society ofAnesthesiologists (ASA) physical status I and II in the age range of 20-70 yearsscheduled to undergo surgeries of the forearm were divided into two groups:Supraclavicular (SCB group) and Infraclavicular (ICB group) of 30 each. Both theblocks were given by 30 mL of 0.375% injection Bupivacaine using a 22G, 5 cminsulated needle and nerve locator. Both the groups were compared with respect tosparing of dermatomes, block performance time, duration of analgesia andcomplications like Horner's syndrome, vascular puncture, and pneumothorax.Statistical analysis was performed with Student unpaired t-test and Chi-square test and $p<0.05$ was considered to be statistically significant.**Results:** Block performance time was similar in both the groups. Duration of analgesia wascomparable among the two groups. The incidence of incomplete radial block wassignificantly higher in ICB group as compared to SCB group (p= 0.046, S). Incidenceof Horner's syndrome in SCB group were higher than in ICB group, but they werestatistically insignificant. (p=0.15, NS). One patient in SCB group had subclavian veinpuncture as compared to none in ICB group and was statistically insignificant.**Conclusion:**Supraclavicular approach for brachial plexus block provides reliable andcomprehensive anaesthesia for forearm surgeries without any significantdermatomal sparing unlike infraclavicular approach. Both groups had similar blockperformance time and duration of analgesia for forearm surgeries. Even though SCBwas associated with complications like Horner's syndrome and vascular puncture, itwas transient and statistically insignificant. Hence supraclavicular approach isconsidered to be superior to infraclavicular approach.

Key words: Supraclavicular infraclavicular peripheral nerve blocks brachial plexus ultrasound-guided regional anesthesia

INTRODUCTION

Peripheral nerve blocks (PNB) have become standard of care for enhanced recovery pathways after surgery. For brachial plexus delivery of anesthesia, both supraclavicular (SC) and infraclavicular (IC) approaches have been shown to require less supplemental anesthesia, are performed more rapidly, have quicker onset time, and have lower rates of complications than other approaches (axillary, interscalene, etc.). Ultrasound-guidance is commonly utilized to improve outcomes, limit the need for deep sedation or general anesthesia, and reduce procedural complications. Given the SC and IC approaches are the most common approaches for brachial plexus blocks, the differences between the two have been critically evaluated in the present manuscript. Various studies have demonstrated slight favourability towards the IC approach from the standpoint of complications and safety. Two prospective RCTs found a higher incidence of complications in the SC approach-particularly Horner syndrome. The IC method appears to support a greater block distribution as well. Overall, both SC and IC brachial plexus nerve block approaches are the most effective and safe approaches, particularly under ultrasound-guidance. Given the success of the supraclavicular and infraclavicular blocks, these techniques are an important skill set for the anesthesiologist for intraoperative anesthesia and postoperative analgesia.

RESULTS

Table 1 shows demographic characters, patients were comparable with respect to Age, Gender, ASA physical status and duration of surgery. Table 2 shows study variables, Block performance time was similar in both the groups. Duration of analgesia was comparable among the two group. The incidence of incomplete radial block was significantly higher in ICB group as compared to SCB group (p= 0.046, S). Table 3 shows complications, as cervical sympathetic chain is close to the brachial plexus in the supraclavicular region, the incidence of Horner syndrome in SCB group were higher than in ICB group, but they were statistically insignificant. (p=0.15, NS) No additional treatment was required taking into account the temporary nature of the syndrome. One patient in SCB group had subclavian vein puncture as compared to none in IC group. Pneumothorax was not reported in our study.

Table 1: Demographic Data

Variables	SCB Group (n=30), n (%)	ICB Group (n=30), n (%)	P-Value
Age (years)	37.74 ± 4.72	34.80 ± 6.74	0.08(NS
Duration of surgery (min)	93.24 ± 41.93	97.67 ± 38.45	0.7098(NS)
Gender: male/female	22/8	23/7	1.00(NS
ASA class I or II	18/12	20/10	1.00(NS)

Table 2: Radial Nerve Sparing, Block Performance Time and Duration of Analgesia

Variables SCB Group	SCB Group (n=30), n (%)	ICB Group (n=30), n (%)	P-Value
Radial nerve sparing	1/30(3.33%)	6/30 (20%)	0.046 (S)
Block performance time (seconds)	224.54 ± 34.38	226.82 ± 37.21	0.8296 (NS)
Duration of analgesia (min)	739.42 ± 25.26	740.52 ± 26.47 0.64 (NS)	0.64 (NS)

Table 3: Complications

Variables SCB Group	SCB Group (n=30), n (%)	ICB Group (n=30), n (%
Horner's syndrome	1(3.33%)	0
Vascular puncture	1(3.33%)	0
Pneumothorax	0	0

DISCUSSION

Supraclavicular and infraclavicular brachial plexus blocks are the two most clinically effective approaches to achieving upper extremity surgical anesthesia. SC and IC require less supplemental anesthesia, are performed more rapidly, have quicker onset time, and have lower rates of complications than other approaches (axillary, interscalene, etc.) [1, 2].

Regarding efficacy between the two approaches, the literature appears less clear on which achieves better outcomes in terms of anesthesia-though the IC method appears to be associated with fewer complications. An RCT of 60 patients examined Ultrasound-guided SC, and IC approaches for sensory and motor blocks, performance time and quality of anesthesia achieved. It was determined that both methods achieved similar

performance time and procedural-related pain scores. The study did find a significant difference in supplementation rate, when required, for the radial territory (18% in the IC group vs. 0% in the SC group). Overall, however, it was determined that both approaches were able to produce a similar degree of surgical anesthesia without supplementation in the majority of cases [3].

Two other RCTs examined the SC vs. IC approaches. One study particularly utilized perineural catheters for ultrasound-guided bolus delivery of anesthesia. In this study, 88% of SC patients and 100% of IC patients achieved sensory block within 30 minutes with no significant differences in the time to complete the procedure. It was thus determined that both approaches provided an optimal block with no true significant differences between the approaches [4]. In the second trial, 150 patients split into two groups (SC vs. IC) were given ropivacaine ultrasound-guided blocks and the mean procedural time, sensory block achieved and failure rate were similar. The only difference noted was a lower incidence of paresthesia in the IC group [5].

Both block approaches have also been supported for use in pediatric populations. The studies concluded both SC and IC approaches achieve a sufficient degree of analgesia for upper extremity procedures. In a randomized trial of 80 children receiving SC or IC blocks (n = 40 and n = 40, respectively), 88% of IC patients achieved surgical anesthesia without supplemental oral analgesia compared to 85% in the SC group. The SC approach was performed more quickly on average in this trial, although it had a higher degree of suboptimal ulnar sensory block. Otherwise, they were both found to be effective approaches and similar in other outcomes measured [6].

A retrospective analysis additionally confirmed similar outcomes for both approaches in pediatric patients. Block procedural time was similar in both, 9.54 ± 2.14 minutes for the SC group and 12.9 ± 2.8 minutes for the IC group. The mean block time for the SC group was 7.5 ± 2 hours and 7.4 ± 1.5 hours in the IC group. No complications were noted, and both were deemed effective and safe for pediatric patients [7].

In various other trials, however, the efficacy of the IC approach appears to be more favorable. An RCT of 120 patients compared SC vs. IC block performance times, efficacy, and complications. In this trial, sensory scores were assessed in seven terminal nerves every 10 minutes until surgical anesthesia was achieved. Patients in the IC group achieved faster onset of anesthesia with greater block efficacy than in the SC group. The SC group demonstrated a better block of the axillary distribution. However, the IC group had a better block of both median and ulnar nerve distributions. Ultimately, the findings supported IC being the faster onset, higher efficacy group with lower incidence of complications. Procedural performance time was not significantly different in this study [8].

In a randomized trial of 60 patients, both SC and IC approaches were compared to continuous peripheral nerve blocks with an ultrasound-guided catheter placement technique. Patients in the IC group had an average pain median of 2. SC group reported a median of 4. The IC group required less overall supplemental oral analgesia as well. Additionally, post-op day one pain scores were examined-the IC group demonstrated lower pain levels in this outcome as well (0.5 vs. 2.0). Thus, in a perineural catheter block, the IC approach was preferred to achieve local anesthesia [9].

The IC method appears to support a greater block distribution as well. In a prospective RCT comparing the various approaches, complete sensory blockade was measured. The trial found complete sensory blockade to be achieved in 57% of patients receiving an SC approach, while 70% in the IC group. The difference was primarily attributed to the SC method being unable to achieve a full ulnar distribution block, whereas the IC approach could [10]. A systematic review further supports these outcomes, noting a higher incidence of complete block in the ulnar distribution across ten randomized trials-though did not find differences in block time, rate of performance, or time of onset. However, it was concluded that the IC approach is preferred due to a significantly lower incidence of complications relative to the SC approach [11].

Overall, both SC and IC brachial plexus nerve block approaches are most effective and safe approaches-particularly under ultrasound-guidance. The literature regarding the differences between the two approaches generally demonstrates similar outcomes regarding both in terms of block onset time, procedural performance and duration of block. However, there is evidence favouring the IC approach due to a more complete block distribution, less need for supplemental oral analgesia and lower incidence of complications-including procedural-related pain, Horner's syndrome and vascular puncture.

However, the imaging time, block performance time, duration of analgesia and the success rate were comparable. We used a high-frequency (7 to 12 MHz) linear arraytransducer ultrasound probe, for better visualisation of the brachial plexus anatomy, and neurostimulation confirmation for performance of blocks in all the groups. Our block performance times were comparable to previous studies using similar techniques [12, 13]. However, Gürkan*et al*. [14] reported shorter performance time for infraclavicular as compared to supraclavicular blockade; we could not demonstrate anydifference in the performance time among groups. In the present study, the onset times of sensory as well as motor block were comparable between supraclavicular and infraclavicular groups. However, the final spread of sensory and motor blockade was comparable among all t approaches.

Our onset times in supraclavicular and infraclavicular groups were similar to the previous study by Gürkan*et al*.[14], whileshorter than that reported by Fredrickson *et al*. [15] and Koscielniak-Nielsen *et al*.[16], which could be explained by the different techniques and the different local anaesthetic agents used in these studies. We observed high surgical effectiveness of the block in all groups. None of the patients required supplemental analgesia during surgery. The duration of blockade and postoperative analgesia were also comparable between the groups. Our success rate in supraclavicular and infraclavicular groups was comparable to previous reports using US-guided nerve blocks [17, 18, 19]. Plante*et al.* [20] also reported greater success rates of anaesthesia in all distal nerve areas by placement of interscalene blocks below the level of C6 nerve roots. Injection below the C6 nerve root allows the diffusion within the deep cervical fascia, offering a wide and homogeneous spread of the local anaesthetic to the entire plexus. Conversely, injection near the C5 nerve root could lead to unintentional subepineural injection that limits the diffusion around the upper primary trunk [21]. In our study, approximately 20 to 30 ml of local anaesthetic was used in each group to obtain surgical anaesthesia. Though low-dose interscalene blockade can be used safely along with general anaesthesia for shoulder surgery, itmay reduce the duration of the block and postoperative analgesia as well as the success rate [22, 23]. The incidence of block-related complications was low in our study. None of our patients had an arterial puncture or local anaesthetic toxicity. This may be due to high-resolution US-guided needle placement followed by confirmation with neurostimulation and the assessment of adequacy of local anaesthetic spread at the time of injection. US guidance not only increases the quality of sensory and motor blockade; by reducing the incidence of paraesthesiae and local anaesthetic systemic toxicity, it may confer greater safety[24, 25].

CONCLUSION

Supraclavicular approach for brachial plexus block provides reliable and comprehensive anaesthesia for forearm surgeries without any significant dermatomal sparing unlike infraclavicular approach. Both groups had similar block performance, time and duration of analgesia, for surgeries. Even though SCB was associated with complications like Horner's syndrome and vascular puncture, it was transient and statistically insignificant. Hence supraclavicular approach is considered to be superior over infraclavicular approach for brachial plexus block.

LIMITATIONS

We did not compare supraclavicular and infraclavicular approaches of brachial plexus block to others like interscalene and axillary.

Approaches

REFERENCES

1. Bharti N, Bhardawaj N, Wig J. Comparison of ultrasound-guided supraclavicular, infraclavicular and below-C6 interscalene brachial plexus block for upper limb surgery: a randomised, observer-blinded study. Anaesth Intensive Care. 2015;43(4):468-72. doi: 10.1177/0310057X1504300408. [PubMed: 26099758].
2. Tran DQ, Russo G, Munoz L, Zaouter C, Finlayson RJ. A prospective, randomized comparison between ultrasound-guided supraclavicular, infraclavicular, and axillary brachial plexus blocks. RegAnesth Pain Med. 2009;34(4):366-71. doi: 10.1097/AAP.0b013e3181ac7d18. [PubMed: 19574871].
3. Arcand G, Williams SR, Chouinard P, Boudreault D, Harris P, Ruel M, et al. Ultrasound-guided infraclavicular versus supraclavicular block. AnesthAnalg. 2005;101(3):886-90. doi: 10.1213/01.ANE.0000159168.69934.CC. [PubMed: 16116009].
4. Harrison TK, Kim TE, Howard SK, Funck N, Wagner MJ, Walters TL, et al. Comparative effectiveness of infraclavicular and supraclavicular perineural catheters for ultrasound-guided through-the-catheter bolus anesthesia. J Ultrasound Med. 2015;34(2):333-40. doi: 10.7863/ultra.34.2.333. [PubMed: 25614407].
5. Dhir S, Brown B, Mack P, Bureau Y, Yu J, Ross D. Infraclavicular and supraclavicular approaches to brachial plexus for ambulatory elbow surgery: A randomized controlled observer-blinded trial. J ClinAnesth. 2018;48:67-72. doi: 10.1016/j.jclinane.2018.05.005. [PubMed: 29778971].
6. De Jose Maria B, Banus E, Navarro Egea M, Serrano S, Perello M, Mabrok M. Ultrasound-guided supraclavicular vsinfraclavicular brachial plexus blocks in children. PaediatrAnaesth. 2008;18(9):838-44. doi: 10.1111/j.1460-9592.2008.02644.x. [PubMed: 18544144].
7. Altinay M, Turk HS, Ediz N, Talmac MA, Oba S. Our Ultrasound Guided Brachial Plexus Block Experiences for Upper Extremity Surgeries in Pediatric Patients. SisliEtfalHastan Tip Bul. 2020;54(2):231-5. doi: 10.14744/SEMB.2018.98958. [PubMed: 32617065]. [PubMed Central: PMC7326672].
8. Koscielniak-Nielsen ZJ, Frederiksen BS, Rasmussen H, Hesselbjerg L. A comparison of ultrasound-guided supraclavicular and infraclavicular blocks for upper extremity surgery. Acta Anaesthesiol Scand. 2009;53(5):620-6. doi: 10.1111/j.1399-6576.2009.01909.x. [PubMed: 19419356].
9. Mariano ER, Sandhu NS, Loland VJ, Bishop ML, Madison SJ, Abrams RA, et al. A randomized

comparison of infraclavicular and supraclavicular continuous peripheral nerve blocks for postoperative analgesia. RegAnesth Pain Med. 2011;36(1):26-31. doi: 10.1097/AAP.0b013e318203069b. [PubMed: 21455085].
10. 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. Anaesthesia. 2009;64(7):738-44. doi: 10.1111/j.1365-2044.2009.05918.x. [PubMed: 19624628].
11. Park SK, Lee SY, Kim WH, Park HS, Lim YJ, Bahk JH. Comparison of Supraclavicular and Infraclavicular Brachial Plexus Block: A Systemic Review of Randomized Controlled Trials. AnesthAnalg. 2017;124(2):636-44. doi: 10.1213/ANE.0000000000001713. [PubMed: 27828793].
12. Arcand G, Williams SR, Chouinard P, Boudreault D, Harris P, Ruel M et al. Ultrasound-guided infraclavicular versus supraclavicular block. AnesthAnalg 2005; 101:886-890.
13. Plante T, Rontes O, Bloc S, Delbos A. Spread of local anesthetic during an ultrasound-guided interscalene block: does the injection site influence diffusion? Acta AnaesthesiolScand 2011; 55:664-669.
14. Gürkan Y, Hosten T, Tekin M, Acar S, Solak M, Toker K. Comparison of ultrasound-guided supraclavicular and infraclavicular approaches for brachial plexus blockade. Agri 2012; 24:159-164.
15. 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. Anaesthesia 2009; 64:738-744.
16. Kessler J, Schafhalter-Zoppoth I, Gray AT. An ultrasound study of the phrenic nerve in the posterior cervical triangle: implications for the interscalene brachial plexus block. RegAnesth Pain Med 2008; 33:545-550.17.
17. .Perlas A, Lobo G, Lo N, Brull R, Chan VW, Karkhanis R. Ultrasound-guided supraclavicular block: outcome of 510 consecutive cases. RegAnesth Pain Med 2009; 34:171-176.
18. Ootaki C, Hayashi H, Amano M. Ultrasound-guided infraclavicular brachial plexus block: An alternative technique to anatomical landmark-guided approaches. RegAnesth Pain Med 2000; 25:600-604
19. Tran DQH, Russo G, Munoz L, Zaouter C, Finlayson RJ. A prospective, randomized comparison between ultrasound- guided supraclavicular, infraclavicular, and axillary brachial plexus blocks. RegAnesth Pain Med 2009; 34:366-371.
20. Plante T, Rontes O, Bloc S, Delbos A. Spread of local anesthetic during an ultrasound-guided interscalene block: does the injection site influence diffusion? Acta AnaesthesiolScand 2011; 55:664-669.
21. Orebaugh SL, McFadden K, Skorupan H, Bigeleisen PE. Subepineural injection in ultrasound-guided interscalene needle placement. RegAnesth Pain Med 2010; 35:450-454.
22. Gadsden J, Shariat A, Hadzic A, Xu D, Patel V, Maliakal T. The sequence of administration of 1.5% mepivacaine and 0.5% bupivacaine does not affect latency of block onset or duration of analgesia in ultrasound-guided interscalene block. AnesthAnalg 2012; 115:963-967.
23. Thackeray EM, Swenson JD, Gertsch MC, Phillips KM, Steele JW, Burks RT et al. Diaphragm function after interscalene brachial plexus block: a double-blind, randomized comparison of 0.25% and 0.125% bupivacaine. J Shoulder Elbow Surg 2013; 22:381-386
24. Gautier P, Vandepitte C, Ramquet C, DeCoopman M, Xu D, Hadzic A. The minimum effective anesthetic volume of 0.75% ropivacaine in ultrasound-guided interscalene brachial plexus block. AnesthAnalg 2011; 113:951-955.
25. Soeding PE, Sha S, Royse CE, Marks P, Hoy G, Royse AG. A randomized trial of ultrasound-guided brachial plexus anaesthesia in upper limb surgery. Anaesth Intensive Care 2005; 33:719-725.