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Ultrasound Guided Axillary Brachial Plexus Block Using Single and Double Perivascular Injection with Bupivacaine versus Conventional Analgesics for Post Operative Analgesia in Forearm and Hand Surgery in Children of 5-12 Years

Dr Richa Tiwari[1], Dr G.Usha[2] , Dr Vineet Kumar[3] , Dr Anju Kumari[1] , Dr Aastha Gaba[1], Dr. Meena Kumari[1]

Junior resident[1] , Professor[2] Department Of Anaesthesiology And Intensive Care Vardhman Mahavir Medical College & Safdarjung Hospital, Guru Gobind Singh Indraprastha University

Senior Resident[3], Department Of Anaesthesia and Critical Care PT.B.D. Sharma PGIMS ROHTAK

Corresponding Author: Dr Vineet Kumar, Senior Resident, Department Of Anaesthesia and Critical Care PT.B.D. Sharma, PGIMS ROHTAK, India

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Abstract

Background: Ultrasound guided axillary brachial plexus block using bupivacaine versus conventional analgesics in forearm and hand surgeries.

Materials and methods: This study was carried out in the Department of Anesthesiology and Intensive Care at Vardhman Mahavir Medical College New Delhi, after seeking clearance from the college ethical committee. Children aged 5-12 years of either sex undergoing elective forearm and hand surgery were randomly allocated to one of three groups. (n=30) each using a computer generated random number table.

Group 1 (n=30) was given single injection perivascular axillary brachial plexus block with 0.25% bupivacaine dose @ 2mg/kg of body weight.

Group 2 (n=30) was given double injection perivascular axillary brachial plexus block with 0.25% bupivacaine dose @ 2mg/kg of body weight.

Group 3 (n=30) was given conventional analgesia in form of intravenous fentanyl (2µ/kg) and paracetamol (15mg/kg) infusion.

Results: Both the ultrasound techniques are comparable and better than paracetamol

Conclusion: Ultrasound guided techniques of axillary brachial plexus blocks (single and double perivascular injection) are superior in the terms of degree and duration of post-operative analgesia as compared to conventional analgesic (injection paracetamol infusion).

Keywords: Ultrasound , Axillary Block , conventional analgesics

Introduction

Provision of adequate pain relief during and after surgical procedure is mandatory to prevent undue suffering to the patient. This can be accomplished either by conventional pain relief medication or rendering the area of the body involved with the surgical procedure anesthetized (regional anesthesia).

Regional anesthesia techniques have the unique property of being able to produce either major modification of afferent sensory input (central nerve blocks)[1,2] or complete blockade of afferent impulse traffic (peripheral nerve blocks). This exclusive property of Regional anesthesia

does not only accomplish excellent intra- and postoperative pain relief but is also associated with a number of other benefits for the patient and the health care system. Many of these benefits are directly linked to the analgesic properties of regional anesthesia[3].

Axillary block is most distal block performed on the brachial plexus and therefore it is associated with negligible risk of the respiratory compromise secondary to pneumothorax or phrenic nerve blockade because of the distal location (in contrast to other brachial plexus approaches). In addition peripheral location permits adequate manual compression to be applied if an inadvertent puncture occurs.[4] Axillary approach is among the most common route of the brachial plexus block in children[5]. It (brachial plexus block including musculocutaneous nerve) results in anesthesia of the upper limb from mid arm down to and including the hand. The axillary nerve itself is not blocked because it departs from the posterior cord high up in the axilla[6]. It blocks the plexus where it has divided into its terminal nerve branches, median, ulnar, and radial nerve. These nerves travels with in axillary sheath so injection in axillary sheath results in blockade of all three nerves, and provide very good surgical anesthesia for forearm and hand surgeries[7].

Children frequently suffer from inadequate management of pain during and after painful procedures. Under estimation of the intensity of pain and fear of high risk of complications due to administration of opioids is an important factor in this regard.

In this present study we have compared two different methods of perivascular injection techniques for axillary brachial plexus block using injection of local anesthetic agent Bupivacaine with conventional analgesic drugs and assessed duration post-operative analgesia and degree of pain relief in children (age group 5-12 years) by using Visual Analogue Scale and Faces Pain Scale-Revised respectively.

Aim and Objectives

1. To compare the efficacy of postoperative analgesia using ultrasound guided single perivascular injection for axillary brachial plexus block with bupivacaine versus conventional analgesia in children aged 5-12 years.
2. To compare the efficacy of postoperative analgesia using ultrasound guided double perivascular injection for axillary brachial plexus block with bupivacaine verses conventional analgesia in children 5-12 years.

Material and methods

This study was carried out in the Department of Anesthesiology and Intensive Care at Vardhman Mahavir Medical College New Delhi, after seeking clearance from the college ethical committee.

Inclusion criteria

A. American society of anesthesiology (ASA) Grade 1 children
B. Children between ages of 5 to 12 years
C. children of either gender
D. Undergoing elective forearm or hand surgery.

Exclusion criteria

The following had been excluded from the ambit of study:-

A. Patient refusal
B. Infection/lesion at the injection site
C. Known hypersensitivity to local anesthetic agents
D. Coagulopathy
E. Difficult positioning

Methodology Patient's selection

Children aged 5-12 years of either sex undergoing elective forearm and hand surgery were randomly allocated to one of three groups. (n=30) each using a computer generated random number table.

Group 1 (n=30) was given single injection perivascular axillary brachial plexus block with 0.25% bupivacaine dose @ 2mg/kg of body weight.

Group 2 (n=30) was given double injection perivascular axillary brachial plexus block with 0.25% bupivacaine dose @ 2mg/kg of body weight.

Group 3 (n=30) was given conventional analgesia in form of intravenous fentanyl (2µ/kg) and paracetamol (15mg/kg) infusion.

Preoperative evaluation and premedication

All children underwent a detailed pre anesthetic evaluation in PAC clinic. A detailed history of present, past and any medication use and a thorough physical examination were performed. A detailed assessment of airway was performed to rule out any airway difficulty. All children were subjected to routine baseline investigations.

The nature of the study was explained to the attendants in his/her own language and written and informed consent was obtained from the parents or responsible attendants willing to participate in the study (Appx- A).

All children were allowed to take solid foods orally till 6 hours before and clear fluids till 2 hours before the scheduled time of anesthesia. Syrup midazolam was given to all patients @ dose of 0.2 mg/kg as premedication.

Children were also be instructed about the use of Faces Pain Scale-Revised (score 0 to 10) and 10cm Visual Analogue Scale (VAS) identifying 0 as “no pain” and 10 as “worst imaginable pain”.

Anesthesia technique: Standardized anesthesia was provided to all children. They were transferred to operating room, monitoring devices, ECG, NIBP, SpO2, EtCO2 was connected and baseline parameters were recorded.

Induction: After 3 minutes of pre-oxygenation, anesthesia was induced with fentanyl 2µ/kg and propofol 2 mg/kg intravenous and nitrous oxide with sevoflurane in oxygen bag and mask. Tracheal intubation was facilitated by 0.1mg/kg vecuronium. Anesthesia was maintained with O2, N2O and isoflurane. IV fluids was provided for maintenance and loss as per body weight of the patient. Pain relief during peri-operative period was provided with IV fentanyl only in conventional analgesic group (group C).

Block Technique

Patient Positioning

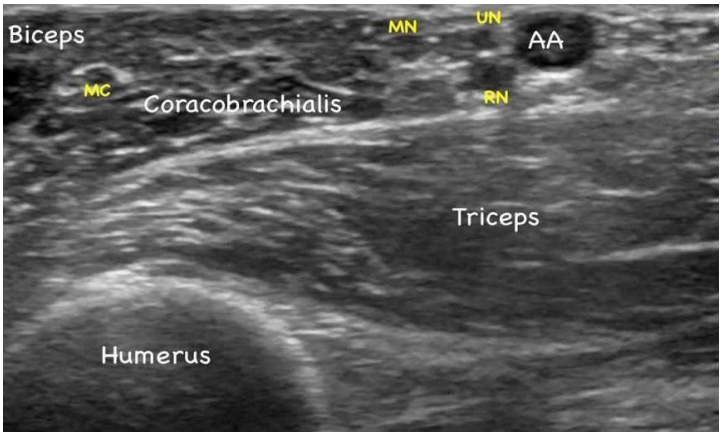
Patient was placed in supine position, and the arm was externally rotated with 90 degree shoulder abduction and 90 degree elbow flexion.

Preparation

Axillary area was cleaned and draped.

The 38 mm, 7.5-15 MHz linear Ultrasound probe covered with sterile vinyl, and placed perpendicular to the anterior axillary fold in cross section to the humerus and bicipital sulcus(at the level of axillary pulse) to capture the transverse or short axis view of neurovascular bundle.

Appearance: The coracobrachialis and biceps brachii seen laterally, teres major and triceps brachii lie medially. The anechoic and circular axillary artery lie centrally adjacent to both biceps and coracobrachialis muscles, axillary artery is surrounded by nerve. The nerve appears round to oval in short axis, generally nerve appear as hyper-echoic mass due to large amount of connective tissue interspersed within the hypo-echoic nerve fascicles. Median nerve is located superficial between the artery and biceps brachii muscle, the ulnar nerve is located medial and superficial to the artery. The radial nerve lies deep to the artery at mid-line. USG probe was positioned so that 3’o clock position is medial and 9’o clock position is lateral with respect to axillary artery. In this view, the 12 o’clock position (closest to skin) faces anteriorly while 6 o’clock is posteriorly. (3)



Nerve block

The block was performed with the In-plane technique using a 22G, 50 mm (length) insulated needle, inserted at acute angle (20-30 degree) to the skin in a lateral to medial direction.

In single peri-vascular technique, needle tip was positioned anteriorly in 12 o'clock position of the axillary artery after assuring that the needle tip is not in the artery, local anesthetic agent was injected and the injection were observed with ultrasonography, and the needle position adjusted if necessary.

In double perivascular technique, 50% of total dose of local anesthetic agent was injected in the 12 o'clock position and remaining 50% was injected in 6 o'clock position posterior to axillary artery.

0.25 % of Bupivacaine as local anesthetic were used according to body weight (2mg/kg of body weight)

In conventional analgesia group (group C) paracetamol (15 mg/kg) was given as intra-venous infusion for post-operative analgesia.

Rescue analgesia was provided if VAS score of more than 5 was observed in group A and group B with paracetamol IV infusion (15mg/kg).

Parameters under study

Vitals: Heart rate, NIBP (systolic, diastolic, and mean) and SpO2 were recorded as baseline before induction, after induction, after nerve block than after every 30 minutes intra-operatively. Post operatively in 5, 15, 30, 45, 60 minutes and at hourly intervals thereafter

Degree of pain relief: Children were instructed about the use of Revised Facial Pain Scale Score and with the help of parental and paramedical staff, postoperative pain will be evaluated by using Faces Pain Scale-Revised (Annexure 2) at rest. Pain was evaluated at 5 min, 15 min, 30 min, 45min, 60min and hourly interval from the completion of surgery.

Duration of pain relief: Children were instructed about the use of VAS score and with parental as well as paramedical support. VAS score was then measured from the time of removal of axillary block needle to appearance of VAS Score (Annexure 1)5 or more VAS 5 or more were considered as need for rescue analgesia.

Evaluation of side effects if any: Children were observed for following side effects:

1. Local trauma/ hematoma
2. Nausea / vomiting
3. Bradycardia / tachycardia
4. Giddiness

Statistical analysis

Statistical tests were applied as follows-

1. Quantitative variables were compared using ANOVA/Kreskas Wallis Test (when the data sets were not normally distributed) between the groups and pair wise

comparison was performed by using independent T test/Mann Whitney test.

2. Qualitative variables were correlated using Chi-Square test /Fisher's exact test. A p value of <0.05 was considered statistically significant.

The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0. And results were interpreted as:

P > 0.05 NS : Not Significant.

P < 0.05 S : Significant.

P < 0.001 HS : Highly Significant

Observations and results

Table No-1: Mean Fps-R Score In Group A

GROUP A	MEAN SCORE
FPR-R(POST OP 5MIN)	0.47
FPS-R(POST OP 15MIN)	0.28
FPS-R(POST OP 30MIN)	0.34
FPS-R(POST OP 1HR)	0.41
FPS-R(POST OP 2HR)	0.29
FPS-R(POST OP 3HR)	0.93
FPS-R(POST OP 4HR)	1.93
FPS-R(POST OP 8HR)	3.25
FPS-R(POST OP 12HR)	4.57
FPS-R(POST OP 24HR)	

Graph No 1: Trend of FPS-R in Group A

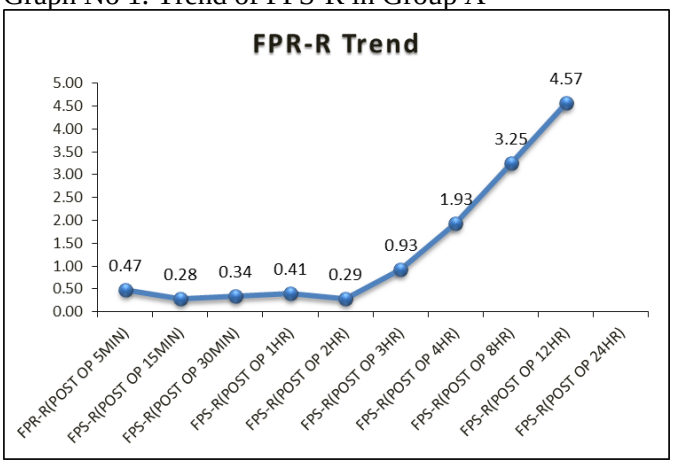


Table No- 2: Trend of FPS-R in Group B

	B
FPR-R(POST OP 5MIN)	0.27
FPS-R(POST OP 15MIN)	0.2
FPS-R(POST OP 30MIN)	0.2
FPS-R(POST OP 1HR)	0.33
FPS-R(POST OP 2HR)	0.73
FPS-R(POST OP 3HR)	1.33
FPS-R(POST OP 4HR)	1.26
FPS-R(POST OP 8HR)	2.52
FPS-R(POST OP 12HR)	3.56
FPS-R(POST OP 24HR)	6

Graph No 2: Trend Of Mean Fps-R In Group B Post Operatively.

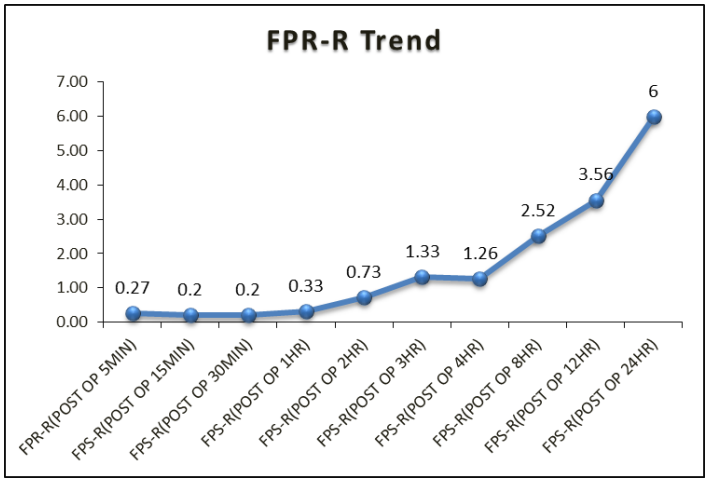
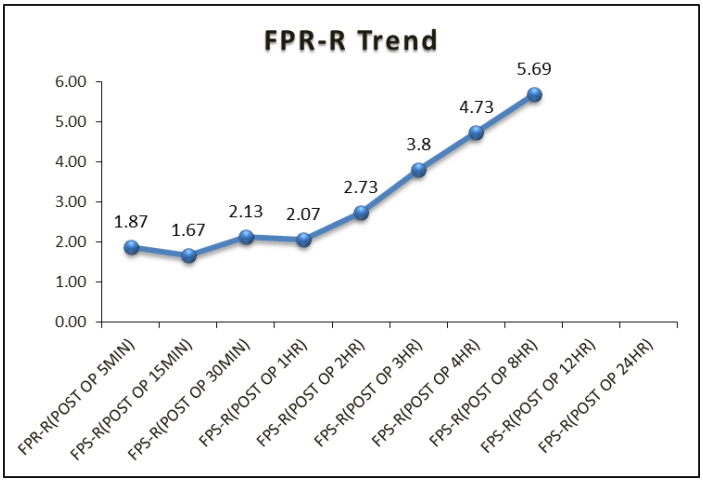


Table no- 3: Trend of FPS-R in group C

	C
FPR-R(POST OP 5MIN)	1.87
FPS-R(POST OP 15MIN)	1.67
FPS-R(POST OP 30MIN)	2.13
FPS-R(POST OP 1HR)	2.07
FPS-R(POST OP 2HR)	2.73
FPS-R(POST OP 3HR)	3.8
FPS-R(POST OP 4HR)	4.73
FPS-R(POST OP 8HR)	5.69
FPS-R(POST OP 12HR)	
FPS-R(POST OP 24HR)	

Graph No 3: Trend Of Mean FPS-R In Group C Post Operatively.



Discussion

Adequate peril operative analgesia in children are very difficult to achieve because of risk of unintentional overdose of opioid analgesics and difficult anatomical landmarks for peripheral nerve blocks .adequate analgesia minimises patient discomfort, facilitate early mobilization and patient recovery.

Axillary brachial plexus block is one of most effective and safe method for postoperative pain relief. There are no major structures which can potentially be damaged at the site of block such as pleura and spinal cord. Vascular puncture is an occasional complication which can simply managed with pressure over affected area.

Brachial plexus block with ultrasound guidance has been shown to reduce the risk of vascular puncture, block time and increase the success rate of block compared to blind technique.

Comparative analysis of hemodynamic parameters in group A &B revealed that the parameters such as PR, SBP, DBP & MAP were comparable throughout the duration of study and were not found statistically significant. However study of group a verses group C and group B verses group C, we found that the hemodynamic changes such as SBP, DBP & MAP were comparable throughout the period of study and was not statistically significant . However we found that changes in PR were significantly higher in group C compared to group A and C and was found to be statistically significant (P value<0.05). This was probably because of inconsistent pain relief in group C.

Lastly, we studied the pain relief characteristics in each group A B and C in terms of degree of pain relief by using FPS-R scale, duration of analgesia using VAS score and the time of rescue analgesia during the post operative period once the child was awake and responded to commands.

On comparing group A and B, VAS score and FPS-R was found to be statistically not significant and comparable in both the group postoperatively (P value >0.05). Mean time for rescue analgesia was 928.83±325.46 and 942±361.23 min respectively in group A and group B (P value 0.976) which is comparable and not significant.

We conclude that Children in group A and group B had comparable degree and duration of analgesia.

Similar result was observed in a Study conducted by Sooyoung Cho et al in 2001, 78 adult patients of ASA status I-II undergoing surgery of the forearm, wrist, or hand comparing single and double, peri-vascular injection technique wth peri-neural injection revealed that there were no differences in onset time. The average induction time was longer in peri-neural group (673.4±149.6 sec) than single injection peri-vascular (557.6±194.9 sec) and double injection peri-vascular (561.5±129.8 sec). There were no differences in the success rate (89.7% vs. 86.2% vs. 89.7%)[8].

A double-blind prospective study done by Carre P1, Joly A et all in 2000 to compare the effect of a single injection versus multiple fractionated doses on the onset time and quality of motor and sensory block in 70 children anaesthetized with axillary block alone with a peripheral nerve stimulator. Axillary blocked done with 0.5 ml.kg-1 of 1.5% lignocaine with adrenaline. In Group S (single injection), the total volume was injected after location of

one nerve. In Group M (multiple fractionated doses), two nerves were located, including necessarily one nerve implicated in the surgical territory. Motor and sensory blocks were assessed according to Lanz's scale before surgery by a blinded observer. No difference was found between groups for motor and sensory block quality. The onset time of the block was faster after multiple fractionated doses (Group M, 25+/-7 min vs Group S, 29+/-4 min) and was faster in younger children (5-9 years: M=23+/-7 min vs S=28+/-5 min, 10-15 years: no difference). There was a significant difference in the quality of the sensory blockade of the musculocutaneous nerve: 18 versus 8 complete blocks, 10 versus 14 incomplete blocks, respectively for Group M versus Group S. No adverse effect was observed and analgesia was prolonged for more than 4 h. concluded that, unlike adults, fractionated doses in children bring no benefit to the quality of sensory and motor block.

This study also supports our results that single and multiple injection techniques of axillary brachial plexus block had comparable degree and duration of analgesia.

On comparing group B verses C, VAS score and FPS-R Score was found to be higher in group C compared to group B throughout the duration of study and patients in group C required earlier rescue with other analgesics, these findings were found to be statistically significant (P value<0.001), Mean time for rescue analgesia was 942±361.23 and 443±121.81 min respectively in group B and group C (P value<0.001). There were statistically significant difference observed in both the group.

We conclude that Children in group B better degree and prolonged duration of analgesia than group C.

These results correlate with those obtained in another study, a double blind randomized control Study done byO. JardeE., Boccard et al to compare the analgesic efficacy and tolerability of parenteral versus oral paracetamol 1g were compared in 323 patients immediately after a hallux valgus plasty performed with local anaesthesia (31 men, 292 women, mean age 52 years). the effects of a single dose of intavenous paracetamol 1gm , oral 1g and placebo were compared in the recovery room 5 hours (mean) after surgery in three parallel groups of patients with at least moderate pain on a 5-point verbal scale. Efficacy was assessed on pain scores rated on a 5-point verbal scale before administration (T0) and 0.25, 0.5, 0.75, 1, 2, 3, 4, 5 and 6 hours after administration and with an overall efficacy 5-point verbal score. Any adverse effects were recorded throughout the duration of the study. PR was statistically superior to plecebo on pain intensity difference (PID) from T30 minutes to T6 hours (Dunnett test), on maximum pain intensity difference (MAXPID) [$p < 0.05$] and summed pain intensity difference (SPID) [$p < 0.05$]. oral was statistically superior to placebo at T1, T2, T4, T5 hours (Dunnett test), on MAXPID ($p < 0.05$) and SPID ($p < 0.10$). PR was statistically superior to PA on PID from T30 minutes to T4 hours, on MAXPID ($p < 0.03$) and SPID ($p < 0.01$). Overall efficacy was found by the patients to be superior with intravenous vs oral ($p < 0.01$), intavenous vs Placebo ($p < 0.05$), and oral vs placebo ($p < 0.10$). In conclusion, intravenous paracetamol provided a significantly greater and longer analgesic effect than the same dosage in oral form[9].

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Conclusion

In this study we compared the two different method of ultrasound guided axillary brachial plexus block (single & double perivascular injection) with conventional analgesic paracetamol to assess the degree and duration of post operative analgesia and concluded that

1. All the groups were comparable in relation to demographic profile and ASA grade.
2. Baseline hemodynamic parameters (SBP, DBP, MAP, PR & SPO2) were found to be comparable in all the groups.
3. All hemodynamic parameters were found to be comparable in group A & group B throughout the study period.
4. Hemodynamic parameters such as SBP, DBP, PR & SPO2 was found to be comparable in group A, B & C throughout the period of study.
5. Pulse rate was found to be consistently higher in group C as compare to group A and B in throughout intra and postoperative period.
6. Degree and duration of pain was assessed by FPS-R and VAS score respectively, patient receiving single and double injection axillary block had comparable degree and duration of analgesia.
7. Patient in group C had significantly lesser degree and duration of analgesia than group A & B patients.
8. Mean duration of rescue analgesia was prolonged in group C as compared to group A & B. Mean time of rescue analgesia in minutes was 928.83 ± 325.46, 942 ± 361.23 and 443 ± 121.81 in group A, B & C respectively.
9. Mean duration of requirement of rescue analgesia was comparable in group A and group B.
10. No side effect was noted in any patient of all groups.

Based on the study, it is concluded that both the ultrasound guided techniques of axillary brachial plexus blocks (single and double perivascular injection) are superior in the terms of degree and duration of post-operative analgesia as compared to conventional analgesic

(injection paracetamol infusion). Both the techniques of axillary block have comparable efficacy.

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