A COMPARATIVE STUDY OF TWO DIFFERENT TECHNIQUES OF BRACHIAL PLEXUS BLOCK IN CHILDREN, INFRACLAVICULAR VS AXILLARY BLOCK

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ABSTRACT

Background: The potential benefits of using ultrasound guidance for regional blocks include the visualization of the surrounding structures (pleura, axillary artery and vein) and the real-time control of the needle movement. **Objectives:** to assure the introduction of ultrasonography to improve the ability to perform these blocks with greater ease and precision. **Patients and methods:** Forty pediatric patients of both sexes (ASA physical status I or II)who were scheduled for upper limb surgery at or below elbow.The ages of the patients were ranging from 5 to 15 years and their body weights from 15 to 55 kg,they were randomly allocated into two equal groups (20 patients each) by sealed envelope. These groups were: Infraclavicular group (groupI) and Axillary group (A) in which both blocks was performed using ultrasound technique. All patients received oral midazolam 0.25 : 0.33 mg/kg as apremedication. All blocks were performed by US-guidance with a Mindray Sonoline unit (DP1100 china), a 5–9 MHz 35 mm linear probe and a short-bevelled needle with extension tube (25–22 G/35–50 mm), All patients were received a sleeping dose of ketamine 1mg/kg with oxygen mask applied then the block was performed. Maintenance of anesthesia was carried out with Isoflurane 1MAC in 50% oxygen/air until the end of the surgery an increase in heart rate or blood pressure ≥10% or an increase in respiratory rate ≥20% and this was considered failed block. Postoperative analgesia was evaluated using modified objective pain score in children from 5 to 10 years old and a numeric pain scale in older children. The following parameters were detected and recorded in each group: Block performance time, The success rate, The duration of sensory and motor blockade, Post-operative analgesia and associated side effects, **Results:** There were no statistically significant results as regard to intra and post-operative analgesia, duration of sensory and motor blockade, however infraclavicular block was quicker to perform compared with the axillary block (7.7±2.3 vs 8.6±3.5) ,higher success rate although non-significant for infraclavicular block compared to axillary block 95.5 vs 90.9 . there was one case of vascular puncture in the infraclavicular group and no vascular puncture in the axillary group. **Conclusion:** Ultrasound-guided infraclavicular BPB can reduce the performance time compared to ultrasound-guided axillary block and there was no significant difference in the success rate, duration of sensory and motor blockade and complications for both blocks.

Keywords: pediatric regional, brachial plexus, ultrasound, infraclavicular, axillary.

INTRODUCTION

The popularity of regional anesthesia as a supplement to general anesthesia in children has grown out of recognition of its advantages beyond simple avoidance of general anesthesia. Suggested benefits include the decreased intraoperative requirement for general anesthetics, less of a need for the use of parenteral opioids thereby limiting the incidence of respiratory depression, and limitation of stress hormone responses. Improved postoperative analgesia and shortened recovery for outpatient surgery have provided further impetus for refinement of techniques that can be used safely in combination with general anesthesia in children **[1]** More recently, as US-guided regional anaesthetic techniques are increasingly being used in children , The main advantages of US-guidance in the blocks of the brachial plexus are the visualization of the surrounding structures (pleura, axillary artery and vein) and the real-time control of the needle movement, both of which reduce the risk of pneumothorax. In addition, US-guidance enables the possibility of reducing the volume of local anaesthetic administered in certain blocks . In children, the main complications of the 'classical' proximal approaches of the brachial plexus are due to either spread of high volumes of local anaesthetic or to pleural/arterial puncture **[2]**.

METHODS

Forty pediatric patients of both sexes (ASA physical status I or II)who were scheduled for upper limb surgery at or below elbow.The ages of the patients were ranging from 5 to 15 years and their body weights from 15 to 55 kg,they were randomly allocated into two equal groups (20 patients each) by sealed envelope. These groups were: Infraclavicular group (groupI) and Axillary group (A) in which both blocks was performed using ultrasound technique. All patients received oral midazolam 0.25 : 0.33 mg/kg as apremedication. All blocks were performed by US-guidance with a Mindray Sonoline unit (DP1100 china), a 5–9 MHz 35 mm linear probe and a short-bevelled needle with extension tube (25–22 G/35–50 mm), All patients were received a sleeping dose of ketamine 1mg/kg with oxygen mask applied then the block was performed. **for infrraclavicular group**: The patient was placed in the supine position, the upper arm adducted to the trunk and the elbow flexed to 90 with the forearm placed on the abdomen, sometimes abduction and external rotation of the arm at the shoulder to optimize visualization of the brachial plexus as it moves the clavicle superiorly and out of the way. The probe was held in a parasagital position . After the brachial plexus had been identified, the ultrasound probe was aseptically prepared by covering the surface with non-sterile ultrasound jelly, slipping it into a sterile glove, and covering the glove with sterile ultrasound jelly. The puncture site was then disinfected and the brachial plexus was once again visualized in the above manner .The needle was inserted immediately cephaled to the probe and in the longitudinal axis of the of the ultrasound beam (In plane approach). A fairly steep angle of needle insertion was used,. Under direct ultrasonographic control, the needle was advanced to the posterior cord of the plexus. At this point, and after negative aspiration local anesthetic mixture was then injected and its distribution around the brachial plexus was confirmed. The needle was redirected when necessary to ensure the target of the block.For axillary group: The needle was redirected when necessary to ensure the targets of the block, *i.e.*, the cords were adequately surrounded by local anesthetic solution. The spread of local anesthetic was seen around the axillary artery and brachial plexus **for axillary group**: The patient was placed in the supine position, the upper arm abducted and the elbow extended. the probe was placed perpendicular to the anterior axillary fold, a short-axis view of the neurovascular bundle can be obtained The needle was directed from superior to inferior using an in-plane approach and after negative aspiration the local anesthetic was deposited posterior to the artery first , to avoid displacing the structures of interest deeper and obscuring the nerves, Once 3-5 mL is administered to block the radial nerve, then the needle is withdrawn almost to the level of the skin, redirected toward the median and ulnar nerves, and the remaining dose is injected in these areas to complete the circle around the artery.

Multiple punctures will be necessary to anesthetize all the relevant nerves for many surgical procedures (*i.e.*, brachial cutaneous, medial antebrachial, and possibly musculocutaneous nerves will require separate blockade).

For the musculocutaneous nerve the coracobrachialis and biceps were observed with the ultrasound probe to find the musculocutaneous nerve which runs between the coracobrachialis and biceps. Then 3- 5 ml of anesthetic was infiltrated around the nerve , a ring of local anaesthetic solution should be injected high around the upper aspect of the arm or a small amount of local anaesthetic injected as the needle is withdrawn after completion of the block to anaesthetize the intercostobrachial nerve. The latter is a branch of the second intercostal nerve that communicates with the medial cutaneous nerve of the arm. The dose of local anesthetic used in both blocks were: 5 mL + 0.25 mL/kg above 10 kg for children wt. from 11-30 kg and 10 mL + 0.15 mL/kg above 30 kg for children wt. from 31-60 kg. These volumes were given as a mixture of bupivacain 0.25% and lidocaine 0.2% in a ratio (1:1) in addition to a test dose of epinephrine 0.5 Mg/kg (5 MIC/mL) up to a maximum volume of 3 mL to exclude intravascular injection. An increase in heart rate of 10 beats per minute above baseline occurring within 1 minute of injection is a reasonable predictor of intravascular injection. Then after block performance a further dose of anesthetics was given (propofol 2mg/kg) and laryngeal mask of suitable size was inserted. Surgical stimulation was allowed within 20 min after block performance. Spontaneous ventilation was maintained throughout the procedure

Maintenance of anesthesia was carried out with Isoflurane 1MAC in 50% oxygen/air until the end of the surgery an increase in heart rate or blood pressure ≥10% or an increase in respiratory rate ≥20% and this was considered failed block. Postoperative analgesia was evaluated using modified objective pain score in children from 5 to 10 years old and a numeric pain scale in older children. The following parameters were detected and recorded in each group:

1] Block performance time (in minutes) : Time to perform both infraclavicular and axillary brachial plexus block is the time from placing of US probe for visualization of brachial plexus after sterlization till injection of local anesthetic mixture around the nerves.
2] The success rate: was determined by the need of any amount of supplemental analgesia during surgery or within the first 4 h since the performance of the block
3] The duration of sensory blockade: Sensory blockade was tested intraopertive by the

absence of the need of any supplemental analgesia and tested postoperative using a simplified pinprick test (pain reaction vs no pain reaction) in the dermatomal distribution for individual nerves (radial, median ,ulnar, musculocutaneous, medial antebrachial cutaneous nerve, medial brachial cutaneous nerve) every 30 min. The duration of the sensory block was defined as the interval between the brachial plexus puncture and the first pain reaction to pinprick test.

4] The duration of motor blockade: The duration of the motor block was defined as the interval between the brachial plexus puncture and the first recovery of one of these movements: forearm flexion-extension, thumb and second digit pinch, thumb and fifth digit pinch or fingers abduction which was tested every 30 min.

5] Post operative analgesia:Postoperative analgesia was evaluated by using the modified objective pain score in children from 5 to 10 years old and a numeric pain scale (from 1 to 10) in older children at 2h, 4h ,6h, 8h interval. Pain scores > 3 on either scale were treated with rectal acetaminophen 30 mg·kg−1 or oral ibuprophen 7.5 mg·kg−1.

6] The associated side effects:

The incidence of each of the following side effects was detected and recorded in each group.

a- Puncture of blood vessels (local hematoma or swelling).

b- Local anesthetic toxicity:
Signs of local anesthetic toxicity throughout the procedure or post operative are recorded.

c- Complications such as pneumothorax, Horner's syndrome or neurological morbidity were looked for.

All patients were auscultated before and after surgery, 6 hours after surgery and before hospital discharge. If there was any clinical suspicion of pneumothorax, then a chest radiograph should be performed. Patients were specifically re-questioned at 1-month follow-up postoperative visit, searching for neurological morbidity.

RESULTS

The results showed that, there were no significant differences among the studied groups regarding their characteristics (age, sex, weight as well as duration of surgery). , there were no significant difference between the intraoperative mean heart rate, blood pressure and respiratory rate in the two studied groups at various times of measurments (after sedation, after block performance, after induction of anesthesia, intraoperative) with their corresponding baseline readings**.** There were significant increase in the measured vital signs (heart rate, blood pressure, respiratory rate) after induction of anesthesia from baseline values and there were significant decrease of respiratory rate from baseline to intraoperative values within each of the 2 groups, However, all these changes were still within the physiological range (20% increase or decrease from baseline).

Statistically ,the postoperative Visual Analogue Scale (VAS) values at different times of measurements (immediately post operative, at 2, 4, 6 hours postoperative were not statistically significant different among the two groups.

The mean block performance times were statistically significant lesser in the infraclavicular group than those of the axillary group

The mean block performance times were 7.7±2.3 min and 8.6±3.5 min in the infraclavicular and axillary groups respectively.

Statistically there were no significant difference in the duration of sensory blockade between both groups. The mean duration for sensory blockade were 358±45.0min and 348±55.0min for infraclavicular and axillary groups respectively.

Statistically there were no significant difference in the duration of motor blockade between both groups The mean duration for motor blockade were 295±38.0 min. and 283±32.0 min. for infraclavicular and axillary groups respectively.

Statistically there were no significant difference in the success rate between the two groups, It was 95.5 vs 90.9 for infraclavicular and axillary groups respectively.

Table (1): Patients characteristics (mean ± SD) and duration of surgery:

Charateristics	Group I (n=20)	Group A (n=20)	T	P
Age (Year)				
• mean ± SD	9.5±3.7	9.4±3.4	0.12	0.74
• Range	5-16	5-16		
Weight (Kg)				
• mean ± SD	26.7±10.4	29±12.0	0.26	0.62
• Range	13-55	16-55		
Duration of surgery / minutes				
• mean ± SD	52.4±17.4	52.1±17.7	0.01	0.92
• Range	30-90	30-90		
Type of surgery				
• Hand surgery	4	7		
• Forearm surgery	6	10		
• Elbow surgery	10	3		

Sex	Group I (n=20)		Group A (n=20)		x^2	P
	N	%	N	%		
Male	11	55.0	12	60.0	0.10	0.75
Female	9	45.0	8	40.0		

x^2 (chi square test)

Data expressed as mean±SD, (Range) number and percentage.

($p > 0.05$) no statistical significant difference

Table (2): Heart rate (b/m) at various times of measurments in the two studied groups

HR (beat/minute)		Group I (n=20)	Group A (n=20)	T	P
Baseline	Range	90-130	90-130	0.02	0.89
	Mean±SD	115±12.0	115.5±12.4		
After sedation	Range	95-130	95-132	0.003	0.96
	Mean±SD	115.1±12.2	115.9±12.2		
After performing the block	Range	89-135	89-132	0.03	0.86
	Mean±SD	113.3±13.1	113.1±12.6		
	Paired t	0.15	0.04*		
After induction of anethesia	Range	82-134	82-122	0.01	0.95
	Mean±SD	106.6±13.5	104.6±12.5		
	Paired t	0.000**	0.000**		
Intra-operative	Range	78-116	78-125	1.62	0.21
	Mean±SD	92.9±10.3	94.8±13.3		
	Paired t	0.000**	0.000**		

Table (3): Mean arterial blood pressure /mm Hg at various times of measurments in the two studied groups

Mean arterial blood pressure /mm Hg		Group I (n=20)	Group A (n=20)	t	P
Base line	Range	70-95	71-96	0.09	0.77
	Mean±SD	86.3±8.0	87±6.9		
After sedation	Range	66-95	71-98	1.96	0.17
	Mean±SD	81.6±8.1	87.3±6.7		
After performing the block	Range	66-93	72-97	2.93	0.10
	Mean±SD	79.8±8.0	87.4±6.5		
	Paired t	0.000**	0.72		
After induction of anesthesia	Range	63-92	69-97	0.93	0.34
	Mean±SD	77±8.1	86.8±7.4		
	Paired t	0.000**	0.25		
Intra-operative	Range	60-86	65-96	0.63	0.43
	Mean±SD	73.6±7.9	81.7±7.4		
	Paired t	0.000**	0.000**		

Table (4): Respiratory rates/minute at various times of measurement in the two studied groups

RR		Group I (n=20)	Group A (n=20)	t	P
Baseline	Range	12-32	14-30	0.37	0.54
	Mean±SD	23.5±7.0	22.1±7.5		
After sedation	Range	12-32	14-35	0.98	0.33
	Mean±SD	23.6±7.2	22.3±7.8		
After performing the block	Range	14-30	12-33	8.53	0.01*
	Mean±SD	22.6±5.5	20.7±7.7		
	Paired t	0.07	0.000**		
After induction of anesthesia	Range	13-31	15-34	4.27	0.05*
	Mean±SD	23.1±5.9	23.2±7.1		
	Paired t	0.34	0.001**		
Intra-operative	Range	12-28	12-28	3.45	0.07
	Mean±SD	19.8±5.2	18.1±6.4		
	Paired t	0.000**	0.000**		

Table (5): Postoperative pain intensity levels at various time of measurements in the two studied groups

VAS		Group I (n=20)	Group A (n=20)	K W	P
Immediately postoperative	Range	0.0- 0.0	0.0-0.0		
	Mean±SD	0.0	0.0		
	Median	0	0		
2 hours	Range	0.0-0.0	0.0-2	3.16	0.08
	Mean±SD	0.0	0.25±0.7		
	Median	0	0		
4 hours	Range	0-2	0-3	0.37	0.54
	Mean±SD	0.7±0.7	0.9±0.9		
	Median	1.0	1.0		
6 hours	Range	0-3	0-3	0.03	0.88
	Mean±SD	1±1.0	1.1±1.0		
	Median	1.0	1.0		
8 hours	Range	1-3	1-3	0.07	0.79
	Mean±SD	1.8±0.7	1.9±0.7		
	Median	2.0	2.0		

K W (Kruskal-Wallis)
(p > 0.5) no statistical significant difference between the two groups

Table (6): Time of block performance:

	Group I (n=20)	Group A (n=20)	t	P
Block performance time				
• mean ± SD	7.7±2.3	8.6±3.5	7.07	0.01*
• Range	5-13	5-15		

Table (7): Duration of sensory and motor blockade:

	Group I (n=20)	Group A (n=20)	T	P
Sensory				
• mean ± SD	358±45.0	348±55.0	0.40	0.53
• Range	310-405	290-403		
Motor				
• mean ± SD	295±38.0	283±32.0	1.17	0.29
• Range	255-335	250-320		

($p > 0.05$) no statistical significant difference between the two groups

Table (8): VI- Failure rate:

Failure	Group I (n=21)		Group A (n=22)		x^2	P
	N	%	N	%	0.27	0.60
	1	0.05	2	0.1		

DISCUSSION

Infraclavicular blocks in this study were performed using the technique described by Chin et al **[3]** (paracorocoid approach)in which the in-plane needle insertion is used under ultrasound guidance, In this study we used parasagittal orientation of the transducer in the infraclavicular fossa which places it very close to the clavicle and lateral needle puncture site was used to perform the block. There was adequate visualization of the plexus in all studied patient . Infraclavicular block in children was also described using the out of plane approach by Marhofer *et al***.[4]** and De Jose Maria *et* ***al.[5].*** In Marhofer study, a linear probe was placed transversely below the clavicle. The needle was inserted out-of-plane, 1 cm from the inferior aspect of the probe, and directed slightly cranially to direct it toward the lateral border of the plexus ,In De Jose Maria study the probe was placed below the clavicle, either parallel to the clavicle or using a slightly parasagittal plane the needle was placed immediately cephalad to the probe. Both groups use a fairly steep angle of needle insertion. These authors report successful visualization of the plexus in all patients studied

Ultrasound imaging is also advantageous in avoiding multiple puncture sites and visualizing underdeveloped structures like the coracoid process that may be difficult to palpate in children using "blind" techniques .This was proved in this study in which there was a single puncture site to perform all infraclavicular blocks and this was in accordance with the results obtained by Marhofer et al and De Jose Maria **[4,6]**.

There is no original report of ultrasound-guided axillary block in children. Three expert reviews were found, which described the technique as performed by the respective authors **[2,7]**.

Intuitively, this block could be performed with similar techniques used in adults, using In-plane needle approach.

Both groups had adequate overall success rates .In this study the success rates were 95.5 vs 90.9 for infraclavicular and axillary groups respectively , in group I (infraclavicular) there was one'failed' block (defined in this study as intraoperative increase in vital signs), in group A (axillary) there were two cases of failed block. There are different success rates for infraclavicular vs axillary block in different studies, Ertug et al **[24]** report (80% vs 86.7%),Fleischmann et al **[13]** report (100% vs 80%), Frederiksen et al**[8]** report (95% vs 77 .5) Heid et al**[9]** report (96.7% vs 100%),Koscielnak et al **[10]** report (53.3% vs 82.8%),Niemi et al **[11]** report (62.1% vs 46.7%) for infraclavicular vs axillary block respectively.

Those difference in success rates are attributed to the difference in the localization technique (anatomical landmarks ,nerve stimulation or ultrasound guidance) ,and are attributed also to criteria used to define the success . Those difference in success rates are attributed to the difference in the localization technique (anatomical landmarks ,nerve stimulation or ultrasound guidance) ,and are attributed also to criteria used to define the success ,and there were several methodological differences between the studies. One of the children in the infraclavicular group[I] was catalogued as 'failed blocks' for this study, was mostly due to intraoperative pain in the radial sensory distribution (as detected from the surgical site) this is in accordance with other studies in adults which have also reported a lower success rate in the radial sensory distribution in US-guided infraclavicular blocks **[12].**

In group A (Axillary) two patients needed intraoperative analgesia because of insufficient musculocutaneous sensory distribution (as detected from the surgical site) and were therefore considered failed blocks for this study.this was in accordance with Rapp and Grau **[7]** who reported that this nerve was undetectable in some children**.[13]** also conclude that One significant shortcoming of the axillary approach is that it has been reported, with varying incidences, to result in incomplete sensory analgesia of the musculocutaneous nerve and its sensory distal branch, the lateral antebrachial cutaneous nerve, the medial brachial cutaneous nerve, and the medial antebrachial cutaneous nerve. By contrast, the lateral vertical infraclavicular approach used in his study which was effective for all these nerves, which was in accordance with the results obtained previously in adults by Karpal et al **[14]** .

In this way, the lateral infraclavicular approach would enhance the spectrum of paediatric surgical procedures covered by brachial plexus analgesia

Our success rate for axillary block (90.9%) was similar to that reported by Lo et al**.[15]** (91.6%) and higher than that reported by C. Luyet, et al**.**(89%) **[16]** and Chan et al**.** (82%)**[17]** but lower than that reported by Casati et al. **[18]** (97%). There are different possible explanations for this difference. First of all, ultrasound had recently been introduced and the individual learning curves to perform a block and even more to teach the technique were possibly not at the highest level. This could represent an institutional learning curve bias However, this is a common situation when a new technique is introduced into clinical practice.

Secondly, complications were recorded. No cases of pneumothorax were recorded in the 43 patients of this study.For infraclavicular block we preferred to use a parasagittal plane (coracoid approach) for IP needle insertion that is lateral to the line of the pleura to reduce the risk of pneumothorax These results was in accordance with the results obtained by Bigeleisen and Wilson **[19]** who compared parasagital with vertical infraclavicular block in adults in and there was higher incidence of pneumothorax in the vertical approach. The parasagital approach was also described by Greher et al. **[20]** and Klaastad et al**. [21]** they also support the finding that this approach is associated with less risk of pneumothorax.

Other complications as vascular puncture were recorded, in the infraclavicular group there was acase with vascular puncture occur in a child aged 14 years and weight about 55 kg ,there was inadequate visualization of the needle path which results in puncture of the axillary vein , The vascular puncture was visualized during US-scanning before the aspiration test, the small hematoma detected by ultrasonography was aspirated under sonographic guidance and the block was abandoned,. Follow up is done postoperative by ultrasonography to confirm that there is no further collection of blood .This child didn't had clinical signs of hemo- thorax, chest wall hematoma or other complications This was consistent with the results obtained by **De José María et al [5].** who compared the efficacy of ultrasound-guided infraclavicular and supraclavicular blocks in children ,these authors report two cases of vascular puncture in the 40 studied patients, However it was higher than that reported in US-guided infraclavicular brachial plexus blocks in adults **(** who described ultrasound guided infraclavicular block in adults ,they report only one case of vascular puncture in 126 studied cases . In the study perfrmed by De Jose Maria et al**.** attribute this complication to the closeness of structures in children and may indicate a higher level of difficulty of the US-guided infraclavicular block of the brachial plexus especially in smaller children. However, in our opinion that inadvertent vascular puncture may have been because of the use of an out-of-plane (OOP) approach instead of the in-plane (IP) approach commonly used in ultrasound-guided infraclavicular block in adults in the studies performed by Bigeleise and Wilson , and Sandhu and Capan **[19,22]**.

In the axillary group there were no cases of vascular puncture and this was consistent with the results performed by Orebaugh et al. **[23]** and C.Luyet, et al. **[16]**. Who conclude that ultrasound guidance dramatically reduced the number of vascular punctures compared to the nerve stimulation technique.

The duration of motor and sensory blockade was measured in this study The mean duration for sensory blockade were 358±45.0 min and 348±55.0 min for infraclavicular and axillary groups respectively,and the mean duration for motor blockade were 295±38.0 min.and 283±32.0 min. for infraclavicular and axillary groups respectively. There was no significant difference between groups as regard duration of sensory and motor blockade and this was consistent with the results reported by Ertag et al. **[24]** and Karpal **[14].**

Finally, we studied the performance times. All patients were scanned looking for ultrasonographic landmarks before measuring the time to perform the block, the results of this study show that the infraclavicular block was faster to perform than the axillary block, as proved by the significantly shorter performance times as it was 7.7±2.3 (range:5-13 min) in group I vs 8.6±3.5 min(range:5-15 min) in groupA). In our study the time to perform both infraclavicular and axillary brachial plexus block is the time from placing of US probe for visualization of brachial plexus after sterilization till injection of local anesthetic mixture around the nerves.

This is consistent with the results of the study performed by Song et al.**[25]** in adults which concluded that ultrasound-guided infraclavicular BPB had a shorter anesthetic performance time than the axillary approach (622±139 sec) vs (789±131sec) for the infraclavicular and axillary groups respectively . In this study the duration of each procedure was measured from the time the Betadine was applied to the skin to the end of the infiltration of the local anesthetic, including the removal of the block needle.

The results were also consistent with the results from the study performed by Tran et al **[26]** in adults which compared the supraclavicular approach, infraclavicular approach, and axillary approach for ultrasound-guided BPB. In their study, the performance time was also shorter for the infraclavicular approach compared to the axillary approach (8.5 mins [SD, 2.3 mins] vs 6.0-6.2 mins [SD, 2.1-4.5 mins] for axillary and infraclavicular blocks respectively.

The difference in the performance time was attributed to that the infraclavicular approach required only one injection of local anesthetic while the axillary approach requires multiple injections for different surgical procedures.

In conclusion, this study suggests that US-guided infraaclavicular brachial plexus blocks using an IP technique may be performed in children >5 years old without a high risk of pneumothorax, by anaesthesiologists already trained in US-guided regional anesthesia. Although not statistically significant, the infraclavicular approach had higher success rate than the axillary block in this study. The statistically significant faster performance of the infrraclavicular approach, together with the lower success rate of the axillary approach, might suggest that the infraclavicur approach could be easier to perform than the axillary one in children.

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