International Journal of
Regional Anaesthesia

Case Report

A Case Report on Bilateral Ultrasound Guided Brachial Plexus Block in a Paediatric Patient with Unusual Congenital Anomalies

Anupama Triparhi Srikanth[1], Pooja Patil[1], Anitha Pramod[1], Srikanth V[1]

[1]Department of Anaesthesiology, Manipal Hospitals, Old airport road, Bangalore, Karnataka, India.

Abstract

Background: Performing bilateral brachial plexus blocks (BPB) in paediatric patients is a rare practice due to concerns like diaphragmatic paralysis, local anaesthetic systemic toxicity, pneumothorax and hematoma formation. The introduction of ultrasound in regional anaesthesia has revolutionized precision, allowing reduced local anaesthetic doses and increased success rates.

Case Description: We present the case of an 11-year-old male, who underwent uneventful surgical repair for tetralogy of fallot at 8 months of age, posted for right index finger pollicization and left-hand distractor frame application. Auscultatory finding of loud S2 and ejection systolic murmur corroborated with echo finding of mild pulmonary regurgitation, intact VSD patch, and good biventricular function. After administering general anaesthesia with controlled ventilation, ultrasound-guided axillary approach bilateral BPB with 11 ml 0.33% Ropivacaine (equal volume mixture of 0.5% and 0.2% Ropivacaine after calculation of maximum allowable dose) was given sequentially on each side with an interval of 2.5 hours. The overall outcome was safe and uneventful.

Discussion: According to the Paediatric Regional Anaesthesia Network, only 3% of all regional anaesthetics (RA) in children involve upper limb blocks. Literature supporting bilateral BPB in children is scarce. RA improves haemodynamic stability, reduces the incidence of postoperative respiratory complications, decreases catecholamine production and the metabolic stress response to surgery and promotes a fast return of gut function and feeding, all of which benefited this child with known cardiac comorbidity. Improvement in the accuracy of ultrasound imaging has undoubtedly boosted regional anaesthetic techniques making nerve blocks safe and well tolerated in children.

Conclusion: Our case report demonstrates successful incorporation of US guided bilateral axillary brachial plexus block in a child with preexisting cardiac illness coming for major upper limb surgeries resulting in a painfree child, satisfied parents and happy surgeons.

Keywords: Bilateral Brachial plexus Blocks (BPB), Paediatric regional anaesthesia, Ultrasound.

Introduction

Bilateral brachial plexus blocks (BPB) are rarely performed in children due to concerns like diaphragmatic paralysis due to phrenic nerve palsy (PNP), Local anaesthetic systemic toxicity (LAST), pneumothorax (PT), and hematoma formation. By incorporating ultrasound (US) in regional anaesthesia (RA), accurate visualization of target nerves has enabled reduction of local anaesthetic (LA) volume used and enhanced the success rate of blocks. In-depth knowledge of ultrasound anatomy, pharmacokinetics of LAs, and technical expertise while performing bilateral blocks is essential to avoid the above-mentioned complications [5].

Address of Correspondence
Dr. Pooja Patil
Department of Anaesthesiology, Manipal Hospitals, Old airport road, Bangalore, Karnataka, India.
Email id: patil24992pooja@gmail.com

Submitted: February 10-07-2024; Reviewed: 02-08-2024; Accepted: 03-10-2024; Published: 10-12-2024

DOI: https://doi.org/10.13107/ijra.2024.v05.i02.104 | www.ijrajournal.com | Online ISSN 3048-9520

Figure 1: Showing absence of thumbs and radial longitudinal deficiency.

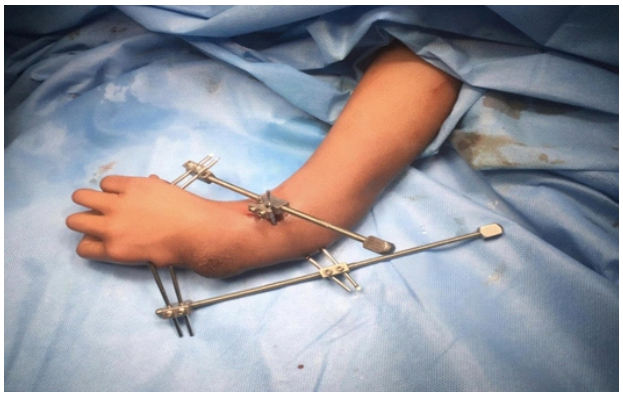

Figure 3: Image of Distractor Frame in place.

We present successful anaesthetic management of a paediatric patient who underwent right hand pollicization of index finger and left hand distractor frame application under US-Guided Bilateral BPB supplemented by general anaesthesia (GA).

Case Report

A 11-year-old male child, first-born to parents of consanguineous marriage, weighing 27 kg, presented with congenital bilateral radial club deformity (absence of thumbs and radial longitudinal deficiency) (Fig. 1). The child, born with tetralogy of fallot, underwent uneventful intracardiac repair {pericardial patch, patent ductus arteriosus (PDA) ligation and patent foramen ovale (PFO) closure} at the age of 8 months under GA. He also underwent an uneventful left upper limb distractor frame application for stage I soft tissue distraction, under GA, at 7 years of age. No other congenital anomalies were noted. He was scheduled for right index finger pollicization and left hand distractor frame application. On auscultation, loud S2 and ejection systolic murmur corroborated with echo finding of residual pulmonary regurgitation. Echo also showed intact Ventricular septal defect (VSD) patch, with no residual PDA/PFO and good biventricular function. Electrocardiography showed heart rate of 67 beats per

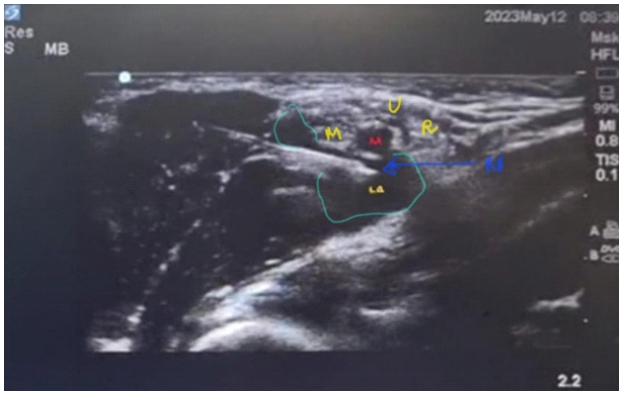

Figure 2: Ultrasound image showing median, ulnar and radial nerves around the Axillary artery. AA: Axillary artery; M: Median nerve; U: Ulnar nerve; R: Radial nerve; N: Needle tip; LA: Local anaesthetic deposit.

minute, sinus rhythm with T wave inversion in lead I, aVL and V1 to V5 leads. Cardiologist opinion for infective endocarditis prophylaxis with intravenous Amoxicillin 50mg/kg to be given 30 minutes before the procedure was duly followed. His airway examination appeared unremarkable and blood investigations were within normal limits. Informed consent was sought from the parents for the anaesthetic procedures. Awake intravenous access was secured on the right foot. Standard ASA monitors were applied. After preoxygenation for 3 minutes and premedication with IV Glycopyrrolate 0.2 mg, intravenous induction was done with Propofol 2 mg/kg, Fentanyl 2 mcg/kg, and Atracurium 0.5 mg/kg. Airway was secured with a 2.5-sized Proseal® Laryngeal mask airway (LMA). Anaesthesia was maintained with Sevoflurane {oxygen: air (50:50) to maintain MAC of 0.9 to 1.2}, mechanically ventilated with tidal volume of 6ml/kg, and relaxant was repeated as per requirement. Maximum allowable dose for Ropivacaine was calculated, which permitted us a total volume of 22 ml of 0.33% Ropivacaine (equal mixture of 0.5% and 0.2% Ropivacaine) to increase efficacy and for a prolonged duration of action. Right-sided axillary BPB was performed with the arm abducted to 90° using 6-15 MHz linear US probe (FUJIFILM Sonosite® edge II, Bothell, WA, USA). After sterilization with 5% Betadine® probe was positioned in mid to distal axilla, perpendicular to the long axis of the arm, adjusted to provide a transverse view of axillary artery. The median, ulnar, radial, and musculocutaneous nerves were visualized around the artery (Fig. 2). A 22-gauge, 50 mm B-Braun® Stimuplex A insulated needle was advanced using an in-plane technique until its tip was positioned posterior to the artery, targeting the radial nerve. 10 ml of prepared LA (0.33% ropivacaine) was slowly injected with frequent aspirations around the radial, ulnar and median nerves to achieve circumferential spread. Subsequently, the needle was redirected towards the

musculocutaneous nerve and one ml of LA was deposited around it. Following completion of the right upper limb surgery, which lasted for two and a half hours, a similar ultrasound-guided axillary BPB was performed on the left side. Sequential block was given to minimize the risk of local anaesthetic systemic toxicity (LAST). The Child remained hemodynamically stable with no opioid supplementation needed during surgery.

Post-surgery, after spontaneous respiration began, LMA was removed after adequate reversal with Neostigmine 0.05 mg/kg and Glycopyrolate 0.01 mg/kg. In the postoperative period, the patient received 15 mg/kg IV Paracetamol 8 hours a day. The patient remained pain-free for up to 12 hours.

Discussion

Regional anaesthesia in paediatric patients is becoming more popular due to the increased availability of ultrasonography. According to the Paediatric Regional Anaesthesia Network, only 3% of all regional anaesthetic procedures in children involve upper limb blocks [1, 2]. RA is known to be superior to opioid based GA in children as it can provide optimal perioperative pain therapy, considering that pain intensity during first 24 hours may contribute greatly to chronicity of pain [2]. Bilateral BPB is usually avoided by anaesthesiologists due to concerns about PNP, PT and LAST. Evidence suggests that US guided bilateral BPB in expert hands can be given in selected patients [6]. We chose to supplement bilateral axillary BPB under US guidance with GA in our patient with residual congenital cardiac anomaly, undergoing major bilateral upper limb surgeries, to reduce intraoperative opioid requirement and enhance postoperative analgesia.

Interscalene and supraclavicular approach BPB can result in inadvertent PNP leading to ipsilateral hemidiaphragmatic paralysis, the incidence of PNP being 21%-100% after interscalene block, 28%-67% after supraclavicular block (SCB) and 5%-13% after infraclavicular block (ICB) [4]. It has been reported that the use of US reduces the incidence of hemidiaphragmatic paralysis by 95% by allowing direct visualization of the phrenic nerve [7, 8]. Since the injection site is anatomically far away from the phrenic nerve, the risk of PNP is less with axillary BPB [9]. In our case, to avoid PNP and to preserve respiratory function, we chose axillary block done under US guidance for precise placement of LA. The risk of pneumothorax during performance of BPBs without US guidance has been reported to be as high as 6.1% for SCB and 0.2% - 0.7% for ICB [10, 11]. Use of ultrasound could minimise or even eliminate this risk [12, 13]. Recent literature reviews showed that the axillary block is the most common, easiest and safest method in paediatric patients [14]. In a review of the literature and case reports, Ramesh and Boretsky discovered that LAST in children occured at an estimated rate of 8 per 1,00,000 blocks, 68% of which occurred under GA and 87% when US was not used [15]. LA levels are found to peak more quickly in blocks above the clavicle than those below [8, 16]. In another study, it was suggested that a time interval of at least 60 minutes should be considered between each block in case of multiple block applications to prevent LAST [4, 8, 9]. In our case, we performed both the blocks using axillary approach. The maximum allowable dose of the LA was calculated according to the body weight and divided between either side. The blocks were given sequentially, such that the time interval of two and half hours between the blocks would prevent the overlap of peak systemic absorption of the LA, thus reducing the risk of LAST. The use of US also helps in precise placement of reduced volume of the LA. Harper et al reported the need for only 2 to 3 ml of LA around each nerve under US guidance [17, 18]. Several practitioners with vast regional anaesthesia experience believe that our current recommended total dose for LAs might be a bit conservative and could be increased [19]. Ropivacaine and Levobupivacaine are thought to carry less potential for systemic and cardiac toxicity than bupivacaine [20]. We had to be more concerned in the choice of LA as our patient had residual preexisting congenital cardiac condition. To increase efficacy and prolong the action of Ropivacaine, we used a combination of 0.5% and 0.2% Ropivacaine to achieve a concentration of 0.33% which resulted in extended postoperative analgesia.

Conclusion

Our case report demonstrates successful incorporation of US guided bilateral axillary brachial plexus block in a child with preexisting cardiac illness coming for major upper limb surgeries resulting in a painfree child, satisfied parents and happy surgeons.

References

1. Polaner DM, Taenzer AH, Walker BJ, Bosenberg A, Krane EJ, Suresh S, Wolf C, Martin LD. Pediatric Regional Anaesthesia Network (PRAN): a multi-institutional study of the use and incidence of complications of pediatric regional anaesthesia. Anaesth Analg. 2012 Dec;115(6):1353-64. doi: 10.1213/ANE.0b013e31825d9f4b. Epub 2012 Jun 13. PMID: 22696610.

2. Zadrazil M, Opfermann P, Marhofer P, Westerlund AI, Haider T. Brachial plexus block with ultrasound guidance for upper-limb trauma surgery in children: a retrospective cohort study of 565 cases. Br J Anaesth. 2020 Jul;125(1):104-109. doi: 10.1016/j.bja.2020.03.012. Epub 2020 Apr 24. PMID: 32340734.

3. Merella, F. et al. Ultrasound-guided upper and lower extremity nerve blocks in children. BJA Education, Volume 20, Issue 2, 42 – 50

4. Şengel A, Seçilmiş S. Ultrasound-guided bilateral infraclavicular brachial plexus block: A report of three cases. Saudi J Anaesth. 2022 Apr-Jun;16(2):232-235. doi: 10.4103/sja.sja_737_21. Epub 2022 Mar 17. PMID: 35431733; PMCID: PMC9009546.

5. Mangla C, Kamath HS, Yarmush J. Bilateral Brachial Plexus Block Using Chloroprocaine For Surgery Of Bilateral Radial Fractures. Local Reg Anaesth. 2019 Sep 27;12:99-102. doi: 10.2147/LRA.S225471. PMID: 31579387; PMCID: PMC6773967.

6. Karim, H.M.R., Panda, C.K., Kumar, M. et al. Perioperative challenges for same sitting bilateral upper limb surgery in a patient of obstructive sleep apnoea, morbid obesity, hypothyroidism, and orthopnea. Ain-Shams J Anaesthesiol 10, 1 (2018). https://doi.org/10.1186/s42077-018-0006-6

7. Renes SH, Spoormans HH, Gielen MJ, Rettig HC, van Geffen GJ. Hemidiaphragmatic paresis can be avoided in ultrasound-guided supraclavicular brachial plexus block. Reg Anaesth Pain Med. 2009 Nov-Dec;34(6):595-9. doi: 10.1097/aap.0b013e3181bfbd83. PMID: 19916254

8. Holborow J, Hocking G. Regional anaesthesia for bilateral upper limb surgery: a review of challenges and solutions. Anaesth Intensive Care. 2010 Mar;38(2):250-8. doi: 10.1177/0310057X1003800205. PMID: 20369756.

9. Kim BG, Yang C, Lee K, Choi WJ. Bilateral brachial plexus block in a patient with cervical spinal cord injury: A case report. Medicine (Baltimore). 2020 Jul 24;99(30):e21126. doi: 10.1097/MD.0000000000021126. PMID: 32791687; PMCID: PMC7387002.

10. Brand L, Papper EM. A comparison of supraclavicular and axillary techniques for brachial plexus blocks. Anaesthesiology 1961; 22: 226–9.

11. Neuburger M, Landes H, Kaiser H. Pneumothorax bei der vertikalen infraklavikulären Blockade des Plexus brachialis. Fallbericht einer seltenen Komplikation. Anaesthesist 2000; 49: 901–4.

12. Tsui BC, Doyle K, Chu K, Pillay J, Dillane D. Case series: ultrasound-guided supraclavicular block using a curvilinear probe in 104 day-case hand surgery patients. Canadian Journal of Anaesthesia 2009; 56: 46–51.

13. Amiri HR, Espandar R. Upper extremity surgery in younger children under ultrasound-guided supraclavicular brachial plexus block: a case series. J Child Orthop. 2011 Feb;5(1):5-9. doi: 10.1007/s11832-010-0303-5. Epub 2010 Nov 23. PMID: 22295045; PMCID: PMC3024489.

14. Majid Fakhir alhamaidah, Hussain AH, Hussein alkhfaji, Sami RH, Hamza Sh. Abd-Alzahra, Ali B. Roomi: Ultrasound-guided brachial plexus blocks in pediatric anaesthesia: non-systematic review. IOP Conf. Series: Materials Science and Engineering 928 (2020) 062013 IOP Publishing doi:10.1088/1757-899X/928/6/062013

15. Singaravelu Ramesh A, Boretsky K. Local anaesthetic systemic toxicity in children: a review of recent case reports and current literature. Reg Anaesth Pain Med. 2021 Oct;46(10):909-914. doi: 10.1136/rapm-2021-102529. Epub 2021 Jun 7. PMID: 34099573.

16. Goh MS, Bernardo MK, Yuen T, Tsai E and Ovsepian M. Bilateral Brachial Plexus Blocks for Bilateral Upper Extremity Surgery. SM J Anaesth. 2017; 3(2): 1013

17. Al-Talabani BG, Abdullah HO, Kakamad FH, Abdulla BA, Salih KM, Mohammed SH, Salih AM. Bilateral brachial plexus block as alternative to general anaesthesia in high-risk patient; a case report and literature review. Ann Med Surg (Lond). 2022 Feb 11;75:103378. doi:10.1016/j.amsu.2022.103378. PMID: 35242325; PMCID: PMC8881413.

18. Harper G.K., Stafford M.A., Hill D.A. Minimum volume of local anaesthetic required to surround each of the constituent nerves of the axillary brachial plexus, using ultrasound guidance: a pilot study. Br. J. Anaesth. 2010;104(5):633–636.

19. Franco CD, Salahuddin Z, Rafizad A. Bilateral brachial plexus block. Anaesth Analg. 2004 Feb;98(2):518-520. doi: 10.1213/01.ANE.0000097441.67236.33. PMID: 14742397.

20. Graf, Bernhard M. M.D.*; Abraham, Ingo M.D.†; Eberbach, Nicole M.D.†; Kunst, Gudrun M.D.‡; Stowe, David F. M.D., Ph.D.§; Martin, Eike M.D.‖. Differences in Cardiotoxicity of Bupivacaine and Ropivacaine Are the Result of Physicochemical and Stereoselective Properties. The Journal of the American Society of Anaesthesiologists 96(6):p 1427-1434, June 1, 2002. | DOI: 10.1097/00000542-200206000-00023

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

How to cite this article: Srikanth AT, Patil P, Pramod A, V Srikanth | A Case Report on Bilateral Ultrasound Guided Brachial Plexus Block in a Paediatric Patient with Unusual Congenital Anomalies | International Journal of Regional Anaesthesia | July-December 2024; 5(2): 27-30 | DOI: https://doi.org/10.13107/ijra.2024.v05.i02.104