



Original Article

Efficacy of Bier's Block in the Surgical Management of Distal Radius Fractures

Authors

Swetha Purohit MD (Anaesthesia)¹, Ramachandra Badami DNB (Orthopaedics)²

¹Assistant Professor, Dept of Anaesthesiology, Subbaiah Institute of Medical Sciences, Shimoga

²Assistant Professor, Dept of Orthopaedics, Subbaiah Institute of Medical Sciences, Shimoga

Corresponding Author

Dr Ramachandra N Badami

T-7, A-Block, Staff Quarters, Subbaiah Institute of Medical Sciences, Purle,
Shivamogga-577222,

Mob No: 9844071476, Email: rnbadami@gmail.com

Abstract

Introduction: Fracture of distal radius is a very common injury, presenting to the emergency department. Most of the fractures are treated by closed manipulation and internal fixation. This requires absolute pain relief for a slightly prolonged duration. Various modalities have been advocated including hematoma block, Bier's block, brachial block, general anaesthesia. We studied the efficacy of Bier's block in the surgical management of distal radius fractures.

Materials and Methods: We prospectively studied 30 patients with distal radius fractures treated with closed manipulation and K-wire fixation under Bier's block. IVRA was performed by using Inj. lignocaine and the dose was calculated as 3 mg/kg body weight. The hemodynamic changes following the block were monitored. The pain relief was assessed using VAS score and the quality of surgical anaesthesia.

Results: The average pre-block VAS score was 7.6 and the average post-block VAS score was 2.2. This difference in VAS score was statistically significant ($P > 0.005$). Regarding quality of surgical anaesthesia, 74% of the patients were in Category-1, 25% patients were in Category-2, only 1 patient was in Category-3 and there were no patients in Category-4.

Discussion: IVRA has been regularly used for treatment of distal radius fractures. The primary advantages are its simplicity, reliability, cost-effectiveness. The present study has shown that the quality of intra-operative anaesthesia and analgesia was good with IVRA for distal radius fractures except for a mild tourniquet discomfort in few. But requires intense intra-operative and immediate post-operative monitoring. We had tachycardia in 6 patients and hypertension in 4 patients during the same period.

Conclusion: Bier's block provides adequate pain relief but requires intense monitoring. It appears to be an attractive option to be practiced safely in field situation when it may be difficult to perform GA or equipment guided plexus blocks.

Keywords: Bier, Block, IVRA, Distal radius.

Introduction

Fracture of the distal radius fractures is a frequent presentation to every Emergency Department with a prevalence of 9/10,000 in men and 37/10,000 in women aged more than 35 years and above^[1,2]. A proportion of these fractures require manipulation within the Emergency Department using the two commonest methods either Haematoma block (HB) or Bier's block (IVRA)^[3,4]. There is evidence to state that haematoma block provides less analgesia and can compromise reduction^[4]. Due to reported toxicity of different local anaesthetic agents, prilocaine or lignocaine are the recommended agents for use in intravenous regional anaesthesia. 0.5% lignocaine at 3mg/kg with a maximum dose of 200mg (40ml) may be used as an alternative to prilocaine^[3]. However, when a single agent is used regularly it minimises risk^[5].

Against this background, it was hypothesized that a combination of HB and IVRA would overcome the drawbacks of each technique and would complement each other. Preceding IVRA with HB would allow proper conduct of IVRA. Both the techniques have been studied independently and also compared with other techniques such as sedation, brachial plexus block, etc^[6-8]. HB and IVRA together are also an attractive option since they do not require expertise or equipments such as ultrasound or peripheral nerve stimulator needed for brachial plexus block and hazards of GA are obviated^[9]. Thus, these techniques can prove to be potentially useful in field situations. Besides, the technique is also suitable for day care anaesthesia. We hypothesized to study the efficacy of IVRA alone without any other added modality. In view of which, a prospective observational case study was undertaken to evaluate the efficacy of IVRA for anaesthetic management of fractures of distal radius.

Materials and Methods

After taking approval of the Ethical Committee, we did a prospective randomized controlled study. The study was carried out on 30 cases over a

period of 1 year between 2015-2016. The inclusion criteria consisted of all the patients between age group of 10 and 75 years in ASA I and II who had sustained closed fractures of distal radius within 7 days of onset, requiring open or closed reduction and internal fixation and were scheduled for a procedure lasting less than 60 min. Patients having cardiovascular co-morbidities, compound or contaminated fractures, peripheral vascular disease, sickle cell disease/trait, coagulation disorders and histories of allergy to the local anaesthetic (LA) agents were excluded from the study. Cases which had to be converted to GA, as well as those which exceeded tourniquet time (60 min) were also excluded from the study. All the patients were subjected to a thorough pre-operative anaesthesia assessment (history, physical examination and relevant investigations). Prior to surgery, patients were explained about the procedure and Visual Analogue Scale (VAS), and written informed consent was taken. The patients were taken up for surgery after ensuring NPO status. Pre-medication was given in the form of inj. midazolam 0.02–0.03 mg/kg IV immediately after establishing the monitoring lines in the OT and baseline assessment of pain was also done by interviewing the patient. Then IVRA was performed by using Inj. lignocaine (plain) and the dose was calculated as 3 mg/kg body weight and diluted with 0.9% saline to form a 0.5% solution of lignocaine^[10].

A double cuff tourniquet was placed on upper arm and not on forearm as adequate arterial compression cannot be obtained. The injured arm is elevated for three minutes to exsanguinate the limb. The cuff is inflated to 100mmHg above the systolic BP or to 300mmHg (whichever is greater). The time of inflation is recorded. Absence of radial pulse is checked. Inj. lignocaine (plain), the dose was calculated as 3 mg/kg body weight and diluted with 0.9% saline to form a 0.5% solution of lignocaine is slowly injected. The time of injection is recorded and the patient is warned about the cold/hot sensation and mottled appearance of the arm. Check for

anaesthesia, may have touch but not pain, after five minutes. If anaesthesia inadequate, flush cannulae with 10-15ml normal saline, cannula removed. Arm lowered on to a pillow and tourniquet checked for any leak. The surgical procedure is then performed. Tourniquet must be under observation at all times and watched for signs of toxicity. The cuff was inflated for a minimum of 20 minutes and a maximum of 45 minutes.

Sensory block was determined to have developed if the patient had no response to pin prick after 3 min of the injection and surgery was then allowed to commence. During the surgery, categorization of the quality of surgical anaesthesia was done according to the criteria as shown in Table 1^[9]. After 15 min of the injection, the distal cuff was inflated to the same pressure as the proximal cuff, and then (only after confirmation of the inflation) the proximal cuff was deflated. Subjective discomfort to tourniquet pressure was also noted and recorded by questioning the patient prior to commencement of the surgery, and thereafter at 15 min intervals. During the procedure, constant recordings of haemodynamic parameters, sensorium and any surgical discomfort as guided by VAS were made. Special effort was made to observe any evidence of drug toxicity, i.e. tinnitus, peri-oral tingling, visual disturbances, dizziness, seizures, level of consciousness, coma, cardiac arrhythmias and hypotension. At the end of the surgical procedure, the cuff deflated. Thereafter the patient was carefully observed and monitored for signs of delayed toxicity until the patient is fully recovered. Then the limb circulation is checked prior to discharge.

Table-1: Quality of surgical anaesthesia.

Category	Description
Category-1	No pain of incision, tourniquet or positioning at any time during surgery
Category-2	Experienced mild pain of tourniquet or positioning but not of incision at any time during surgery
Category-3	Experienced mild to moderate pain of surgery or experienced discomfort or pain of positioning or tourniquet at any time during surgery
Category-4	No pain relief. Patient required additional/supplemental anaesthesia in the form of sedation or GA/DA

Results

A total of 30 cases with distal radius fractures were subjected to the study. The age ranged between 20 and 60 years, with a mean 38 years. The average duration of surgery was 35 min with a range of 22–48 min. All patients were treated with closed reduction and K-wire fixation. The average pre-block VAS score was 7.6, ranged from 6-9. The average post-block VAS score during the fracture manipulation was 2.2, ranged from 0-4. This difference in VAS score between the pre-block and post-block status was statistically significant ($P>0.005$).

Regarding quality of surgical anaesthesia, 74% of the patients were in Category I which meant that they had a VAS of 0-1 and did not have any pain of incision, tourniquet or positioning at any time during surgery. Only 25% patients were in Category-2, who experienced mild pain of tourniquet or positioning but not of incision at any time during surgery. There was only one patient who fell in Category III i.e. he experienced mild to moderate pain of surgery or experienced discomfort or pain of positioning or tourniquet at any time during surgery. The duration of surgery for this patient was 58 min. There were no patients in Category IV and none of the patients needed any additional/supplemental anaesthesia in the form of sedation or GA. Most of the patients remained stable haemodynamically. Tachycardia was noted in 6 patients (Pulse rate between 90-110/min) intraoperatively. Intra-operative hypertension (Blood Pressure between 156/92 to 178/100) was seen in 4 patients. None of the patients had any signs of LA toxicity either during or after the surgery. There were also no complications such as infection, compartment syndrome, etc.

Discussion

Pain relief is of utmost importance in distal radius fractures which may need manipulation immediately for reduction followed by operative intervention. Amongst various techniques, hematoma block, brachial block and IVRA are

attractive options. However, while HB offers immediate and adequate pain relief, it is inadequate for operative intervention. Brachial block is time consuming, requires expertise, but has a good success rate. IVRA is fast acting, produces immediate pain relief and can be used for a day care procedure. But it requires precise tourniquet pressures and post operative monitoring for any adverse effects. Based on this premise, this study focused on the use of IVRA for the surgical treatment of distal radius fracture, which do not require sophisticated equipment, and hence were also possible in a situation where resources are limited. IVRA suffers from many limitations. Besides other factors mentioned earlier, concerns include the risk of LA toxicity and unsatisfactory exsanguination due to pain at the fracture site^[11]. Inadequate exsanguination leads to an increased risk of LA toxicity and poor quality of block^[12]. Hence some studies have advocated concurrent use of hematoma block for reduction of pain during exsanguinations^[9].

The present study has shown that the quality of intra-operative anaesthesia and analgesia was good with IVRA for distal radius fracture manipulation and internal fixation except for a mild tourniquet discomfort in few. It is well known that post-operative analgesia after IVRA is transient even though ropivacaine is likely to offer better postoperative analgesia than lignocaine^[13]. In our study too, there was near-absence of postoperative analgesia. Generally, 0.5-1.5% lignocaine is used for IVRA. But the researchers have used varied concentrations of 1–10% lignocaine and even prilocaine^[6,7,14,15]; however, all studies have used a fixed volume dose. There is a potential concern related to use of combination of LA and their total dose. In our study, while total doses of LA agents were kept well below the safe limit. Occurrences of LA toxicity following HB are unlikely and this fact has been supported by several studies^[4,7,14]. Here, it is pertinent to mention that the fracture haematoma behaves as a closed compartment and is isolated from the rest of the circulation^[16]; Even though HB is safe, a cases of osteomyelitis and

compartment syndrome have been reported^[17,18]. Also HB alone is not adequate for operative intervention.

IVRA by itself has been regularly used for treatment of distal radius fractures. The primary advantages of IVRA are its simplicity, reliability and cost-effectiveness. However, one of the major limitations of IVRA continues to be the lack of postoperative analgesia following tourniquet deflation^[19]. It has been compared with HB and as noted by Kendall et al., IVRA is superior in terms of efficacy, radiological result and remanipulation rate^[20]. The drug of choice for IVRA is lignocaine even though a number of agents and additives have been used. According to a recent review, ropivacaine is likely to be a better alternative to lignocaine for IVRA which provides a prolonged post-tourniquet release pain relief as compared to lidocaine^[13,19]. Mohr also described IVRA to be safe, effective, reliable technique with a recommendation of using a 0.5% solution of lidocaine in a dose of 1.5–3mg/kg^[10]. We used a 1% solution of lignocaine at a dose of 3mg/kg and did not come across any evidence of drug toxicity. However, in a systematic review (spanning 1950–2007) of complications of IVRA, seizures were reported with lidocaine at its lowest effective dose (1.5 mg/kg) as well as seizures occurring after tourniquet deflation were seen with a tourniquet time as long as 60 min^[21]. However, all these events can be termed as extremely uncommon.

The technique itself is not without drawback. It is fairly time consuming (around 30 minutes per procedure) and it requires two doctors to work with one patient for most of that time. Additionally, the patient needs to be monitored until fully recovered from the procedure and are ready to go home (if appropriate). This consumes nursing time and resources. However, overall costs are still likely to be less than inpatient care and operative intervention^[22].

The main limitation of the study was that it did not compare other modalities of anaesthesia to IVRA with respect to the distal radius CRIF surgeries. Hence cannot accurately determine the

superiority of one modality of anaesthesia over other.

Conclusion

IVRA produces significant anaesthesia and analgesia for the surgical treatment of distal radius fractures. But requires precise technique, accurate dosing of the LA used and thorough intra-operative and immediate post-operative monitoring. It appears to be an attractive option to be practiced safely in field situation when it may be difficult to perform GA or equipment guided plexus blocks.

Reference

- O'Neill T, Cooper C, Finn JD et al. Incidence of distal forearm fracture in British men and women. *Osteoporos Int* 2001; 12(7): 555-8.
- Wadsworth TG. Colles' fracture. *Br Med J* 1990; 301(6745): 192-4.
- O'Sullivan I, Brooks S, Maryosh J. Is fasting necessary before prilocaine Bier's block? *Br Med J* 1996; 13: 105 – 7.
- Kendall JM, Allen PE, McCabe SE. A tide of change in the management of an old fracture? *J Accid Emerg Med* 1995; 12(3): 187-8.
- Bier A (1908) Uperinenveven Weglocalanaesthesian den Gliedmassenzuerzeugen *Arch. Klinische Chirurgie* 86 1007.
- Bajracharya S, Singh S, Singh G, Singh M, Bajracharya T. The efficacy of the haematoma block for fracture reduction in the distal forearm fractures: a double blind randomized controlled trial. *Internet J Anesthesiol.* 2007;17(2).
- Luhmann JD, Schootman M, Luhmann SJ, Kennedy RM. A randomized comparison of nitrous oxide plus haematoma block versus ketamine plus midazolam for emergency department forearm fracture reduction in children. *Pediatrics.* 2006;118(October (4)):e1078–e1086.
- Man KH, Fan KP, Chan TN, Yue YM, Sin FP, Lam KW. A prospective clinical trial comparing self-administered nitrous oxide and haematoma block for analgesia in reducing fractures of the distal radius in an emergency department. *Hong Kong J Emerg Med.* 2010;17:126–131.
- Col R.N. Verma a,* , Brig Shahbaz Hasnain b, Col D.K. Sreevastava c, Brig T.V.S.P. Murthy (Retd)d, Anaesthetic management of forearm fractures using a combination of haematoma block and intravenous regional anaesthesia, *medical journal armed forces india* 72(2016) 247–252.
- Mohr B. Safety and effectiveness of intravenous regional anesthesia (Bier block) for outpatient management of forearm trauma. *CJEM.* 2006;8(July (4)):247–250.
- Rodolà F, Vagnoni S, Ingletti S. An update on intravenous regional anaesthesia of the arm. *Eur Rev Med Pharmacol Sci.* 2003;7:131–138.
- Davies JAH, Wilkey AD, Hall ID. Bupivacaine leak past inflated tourniquets during intravenous regional anaesthesia. *Anaesthesia.* 1989;39:996–999.
- Ahmad A, Nisa WU, Farooqi A, Ahmad I, Taj T, Ahmad S. Ropivacaine is a better alternative to lidocaine in intravenous regional anesthesia. *Anaesth Pain Intensive Care.* 2014;18(1):6–10.
- Myderrizi N, Mema B. The haematoma block an effective alternative for fracture reduction in distal radius fractures. *Med Arch.* 2011;65(4):239–242.
- Fathi M, Moezzi M, Abbasi S, Farsi D, Zare MA, Hafezimoghadam P. Ultrasound-guided haematoma block in distal radial fracture reduction: a randomized clinical trial. *Emerg Med J.* 2015;32(June (6)):474–477.
- Kolar P, Schmidt-Bleek K, Schell H, et al. The early fracture hematoma and its

- potential role in fracture healing. *Tissue Eng B Rev.* 2010;16(August (4)):427–434.
17. Basu A, Bhalai V, Stanislas M, Harvey IA. Osteomyelitis following a haematoma block. *Injury.* 2003;34:79–82.
 18. Younge D. Haematoma block for fractures of the wrist: a cause of compartment syndrome. *J Hand Surg Br.* 1989;14:194–195.
 19. Flamer D, Peng PW. Intravenous regional anesthesia: a review of common local anesthetic options and the use of opioids and muscle relaxants as adjuncts. *Local Reg Anesth.* 2011;4:57–76.
 20. Kendall JM, Allen P, Younge P, Meek SM, McCabe SE. Haematoma block or Bier's block for colles' fracture reduction in the accident and emergency department – which is best? *J Accid Emerg Med.* 1997;14(November (6)):352–356.
 21. Guay J. Adverse events associated with intravenous regional anesthesia (Bier block): a systematic review of complications. *J Clin Anesth.* 2009;21(December (8)):585–594.
 22. Graham CA, Gibson AJ, Goutcher CM, Scollon D. Anaesthesia for the management of distal radius fractures in adults in Scottish hospitals. *Eur J Emerg Med* 1997;4(4):210-2.