

## Hematoma block for fracture reduction

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### Abstract

**Introduction:** Distal radius fractures are one of the commonest fractures and more commonly involve children and elderly. Analgesia during reduction are determined by safety, simplicity, effectiveness and costs. The objective of this study is to evaluate the effectiveness of the Hematoma Block (HB) for reduction in distal forearm fractures in a developing country like Nepal.

**Methods:** The study design was double blind randomized control trial performed at tertiary care hospital from July 2016 to August 2017. The patients having radiologically confirmed distal forearm fractures less than 96 hours old in 46 males and 54 females included after obtaining informed consent. 50 patients receiving Brachial Plexus Block (BPB group), and 50 patients receiving HB group during reduction of distal forearm fractures were initially allotted in two arms of randomized group. Pain measured by Visual Analogue Scale (VAS) was recorded before, during, and after reduction.

**Results:** The study showed that HB with (mean  $\pm$  SD) a VAS score of  $2.08 \pm 0.85$  was as effective as BPB with a VAS of  $1.7 \pm 0.64$  in terms of producing analgesia ( $p=0.013$ ), with the advantage of no motor paralysis and a significantly higher reduction rate, odds 3.45, 95% CI 1.52 – 7.85,  $p = 0.0013$ . 1/50 patients in brachial plexus block had bronchospasm needing intubation and ICU care where as 1/50 patient with hematoma block and infection which needed incision drainage and external fixation for complete healing.

**Conclusions:** “The Hematoma Block” is to be encouraged in our set up for the reduction of the distal forearm fractures. The technique may be used in those fractures like isolated ulna fractures, minimally displaced tibial fractures, fracture fibula where local anesthesia can be easily infiltrated percutaneously. The study may be beneficial in managing such fractures and hence, it will help change in therapeutic policies comparing other modalities.

**Keywords:** Brachial Plexus Block; Distal forearm fractures; Hematoma Block; Visual Analog Scale.

### Introduction

Fractures of the distal radius are one of the commonest fractures, accounting for one sixth of all fractures seen in emergency rooms. They more commonly involve children and elderly. These fractures more frequently affect women, increase in frequency with advancing age, and result from low energy falls more often than from high energy trauma<sup>1,2</sup>.

The characteristic features of ideal analgesia during reduction are determined by safety, simplicity, effectiveness and costs. Given the logistic difficulty of providing such anesthesia to such large number of patients requiring management at peripheral setups simpler alternatives to conventional anesthesia have been tried. Hematoma Block (HB) alone, HB with sedation, Bier's Block (Intravenous regional anesthesia), regional nerve blocks, sedation have

been compared to general anesthesia to evaluate the efficacy, effectiveness, safety in treating distal radial fracture in adults.<sup>3-10,12,14,19-20</sup> Brachial Plexus Block (BPB) is skillful procedure in which needs trained anesthesiologist and complications of BPB like pneumothorax is considered. If simpler procedures administered by orthopaedic surgeons are as safe and equally effective then they can be viable and practical alternatives to the conventional management. Hence this trial was conducted at a tertiary care center, a simple, safe procedure HB compared to BPB to quantify advantages in cost, effectiveness and safety.

## Methods

The present study was carried out in a tertiary care hospital from July 2016 to August 2017 after receiving approval from Institutional Review Committee of KIST Medical College. All adult patients with distal forearm fractures were included in the study after obtaining informed consent. Patients were randomized (by computerized random number generation technique) into two equal groups namely Group A; in short “BPB group”, receiving BPB; and Group B; in short “HB group”, receiving HB for reducing distal forearm fractures. This prospective randomized controlled trial was carried out with 50 patients in each group.

In the study, all the patients who received any sort of analgesics within 8 hrs of manipulation and fractures not requiring manipulation (undisplaced fractures) were excluded.

The variables studied were A) Level of pain before, during and after reducing the fractures by Visual Analogue Scale (VAS); B) Vital parameters before, during and after manipulation (pulse rate, respiratory rate, blood pressure and oxygen saturation); C) quality of reduction after manipulation by radiographs and; d) complications during and post reduction.

Statistical Analysis used was measurement of magnitude of difference between values of outcomes in the two groups. Qualitative data analysis by Chi Square, Quantitative data analysis by Student T test, and Quantitative not normally distributed data by non parametric test like KW statistics. Control of residual confounding if any was done by regression analysis; and lastly control of measurement bias was corrected by blinding/objective measurement. Pre-anesthetic evaluation was done in both groups. In all cases intra venous route was accessed by intra-venous cannula and electronic monitor was connected to continuous record of pulse rate, respiratory rate, blood pressure and oxygen saturation by pulse oxymetry. All patients undergoing procedure were kept NPO, irrespective of procedures. In all cases, hypersensitivity for lignocaine (xylocaine) was

tested. After tests for xylocaine (Astrazeneca Lidocaine Hydrochloride)<sup>29</sup> sensitivity, the **A Group** was given BPB (dose according to body weight 4.5-7mg/kg)<sup>27</sup> by the trained anesthesiologist (Registrar/Consultant) at fracture clinic in the supraclavicular approach of BPB under guidance of nerve stimulator whereas the **B Group** was given 1.5% lidocaine (amount according to body weight-4.5 mg/kg)<sup>25- 28</sup> at the fracture hematoma site from the dorsal aspect.<sup>24</sup> All the HB was given by qualified Orthopaedic surgeon (Senior Registrar). Prior to the injection of the drugs, the part was painted first with spirit (95% alcohol), then with 7.5% povidone iodine. The calculated amount of xylocaine was taken in a 20 ml disposable syringe with 22<sup>1/2</sup> Gauge needle. The needle was placed at the fracture hematoma site, ascertained by passing needle in between fracture site away from known anatomical blood vessels and by aspirating about 1 to 2 ml of hematoma blood. No massage was done at the fracture site after injection of the drug. The drug was given by junior resident (J<sub>1</sub>) under the supervision of consultant at well equipped fracture Clinic. After ten to fifteen minutes<sup>27</sup> the reduction and immobilisation of the fracture was done by junior resident blinded to the anesthesia technique (J<sub>2</sub>). Upon failure of block even after 15 minutes, it was excluded from and alternate modalities like IVA was considered. To avoid biasness about the technique (injection site mark), stockinet was used on the forearm to conceal the injection site irrespective of groups. Visual Analogue Scale (VAS) was recorded for evaluation of pain before, during, and after reduction by the junior resident of orthopaedics on duty (J<sub>3</sub>) blinded to the anesthesia technique used for manipulation of the fracture. Vital parameters were recorded before, during and after manipulation. Patients requiring rescue analgesics would be labeled as failures and excluded from the study.

Quality of reduction was assessed by radiographs immediate post reduction. The acceptability of the reduction was evaluated by the consultant surgeon on call blinded to the anesthesia technique used. The radiological criteria were based on the Modified Sarmiento Criteria for post reduction acceptability varying between perfect, acceptable and unacceptable. According to which perfect reduction consists of excellent and good results, acceptable reduction consists of fair result; and unacceptable consists of poor results. Radiological assessment was categorized from excellent to poor. (Table 1)

Patients were followed up on the next day post reduction for neurovascular assessment. Follow up at the 10<sup>th</sup> day, 4<sup>th</sup> and 6<sup>th</sup> week were done to evaluate the post reduction complications.

**Table 1 Criteria for anatomical result**

Result	Criteria		Modified Criteria
<b>Excellent</b>	No or significant deformity	Dorsal angulation $\leq 0^\circ$ Shortening <3mm	<b>PERFECT REDUCTION</b>
	Slight deformity	Loss of radial deviation <4° Dorsal angulation 1-10°	
<b>Good</b>		Shortening 3-6mm	
<b>Fair</b>	Moderate deformity	Loss of radial deviation 5-9° Dorsal angulation 11-14°	<b>ACCEPTABLE REDUCTION</b>
		Shortening 7-11mm	
<b>Poor</b>	Severe deformity	Loss of radial deviation 10-14° Dorsal angulation >15°	<b>UNACCEPTABLE</b>
		Shortening $\geq 12$ mm	
		Loss of Radial deviation >15°	

After Sarmiento et al.<sup>30</sup> modification from Lidstrom<sup>31</sup>.

**Results**

Age group in both BPB an HB groups are comparable and most of the patients were males and were right handed. Sides of the fracture involved were similar in both groups. Displaced fractures were included compared to minimally displaced fracture (Table 2)

**Table 2 Demographic characteristics of the study population**

Some demographic characteristics of the study population			
Characteristics	BPB Group(n=50)	HB Group(n=50)	P value
Age in years	43.58±18.68	44.96±18.39	0.710
Sex Male: Female	22:28	24:26	
Handedness L: R	2:48	1:49	
Side of fracture L: R	26:24	28:22	
Fracture Duration (hrs)	7.56±7.32	11.86±12.12	0.0351
Displacement D:MD	39:11	38:12	

There were different modes of injury to the distal end of the radius like slip on the ground, fall from a height, a ladder, a tree, a bicycle etc. Among them, trivial trauma was the commonest mode of injury occurring Colles’ fractures.

The mean duration of injury is 7.54±7.32 hrs in the BPB group and 11.86±12.12 hrs in the HB group without much significance. Most of the BPB group patients were not splinted at the time of presentation at the emergency room (ER) or the orthopaedics outpatient department. 65 patients out of 100 were not splinted and among them 38 were in the BPB group and 27 in the HB group.

Total of 75 patients did not take any form of analgesic prior to the reduction where as 25 patients took analgesic 8 hrs prior to the reduction. Among them, 43 patients were in the BPB and 32 in the HB. Fractures at the distal end of radius were divided into displaced and minimally displaced. Displaced and minimally displaced fractures were equally distributed in both the groups showing 39 and 38 displaced fractures, and 11 and 12 minimally displaced fractures in the BPB and the HB group respectively.

Visual Analogue scale before the reduction were  $7.60 \pm 1.32$  and  $7.68 \pm 1.16$  in the BPB group and the HB group respectively. VAS before reduction of fracture did not differ between groups. Visual Analogue score recorded in 5 min and 10 min of the block, and during and after the reduction. It showed that before procedure pain was same but after 5 min and 10 min it was significantly decreased. (Table 3)

**Table 3 Visual Analogue Scale Before and After reduction**

	BPB	HB	P- value	K-W test
VAS Before reduction	7.60±1.32	7.68±1.16	0.7495	0.6048
VAS after 5 min	2.9±0.80	2.9±0.90	0.9075	0.7210
VAS after 10 min	1.78±0.73	2.02±0.65	0.0881	0.1239
VAS during procedure	1.70±0.64	2.08±0.85	0.0137	0.0161
VAS after procedure	0.72±0.49	0.92±0.633	0.0821	0.1107

The post reduction fracture configuration in each group of patients after taking anteroposterior and lateral view radiographs revealed that quality of reduction towards perfect was significantly high in HB group. 32 out of 50

reductions were perfectly reduced in the HB group whereas only 17 out of 50 in the BPB group. The acceptability of fracture reduction in HB was odds of 3.45 times than that of the acceptability of fracture reduction in BPB (Table 4)

**Table 4 Post Reduction fracture configuration and Significant P-value showing acceptability of reduction in the HB group**

	BPB	HB	Total	
Perfect	17	32	51	
Acceptable	33	18	49	
	Odd Ratio	Lower	Upper	P value
Acceptability of reduction	3.45	1.52	7.85	0.0051

Various complications encountered during the study from the time of reduction to the 6<sup>th</sup> week after reduction showed that in both groups it was not significantly different but potentially danger complications like bronchial spasm needing intubation was encountered in BPB group. [Table 5]

**Table 5 Complications encountered in both the groups**

Complications	BPB	%	HB	%
	(n=50)		(n=50)	
1. Swelling of Hand post reduction requiring cast splitting and re application of cast	2	4%	2	4%
2. Displaced and re-manipulation needed in 10 <sup>th</sup> day of reduction	1	2%	1	2%
3. Bronchial spasm and needed Intubation soon after the Block	1	2%	-	-
4. Infection at the block site at 10 <sup>th</sup> day	-		1	2%
5. Minimally displacement of reduction on 4 <sup>th</sup> week of post reduction.	-		1	2%

**Discussion**

The popularity of the HB in reducing Colles’ fracture is well documented.<sup>13</sup> An increasing awareness of cost and time with the National Health Service contributes to a marked change in the anesthetic management of Colles’ fractures, and demonstrates the increasing popularity of the Hematoma Block in term of the expenses incurred by the general anesthesia for fracture reduction.<sup>13</sup> The expense for HB is far less in compare to general anesthesia or BPB. Local and regional anesthetic techniques can be safely performed by ‘Accident & Emergency’ doctors, with appropriate monitoring, and this has beneficial resource implications for the anesthetic department and the hospital. A Cochrane Database review of 18 studies involving about 1200, mainly female and older patients with fractures of the distal radius in adults concluded that all studies had serious methodological limitations, remarkably in the frequent failure to assess clinically important factors and longer term outcomes.<sup>21</sup> The pain relief during reduction measured by Visual analogue scale, the acceptability of reduction in terms of post reduction radiographic configuration and complications associated with the type of anesthesia used are three main aspects of this study.

**The pain relief during reduction measured by VAS**

In the present study Visual Analogue Score during manipulation in the both groups were comparable i.e., 1.7 in the Brachial Plexus group and 2.08 in the Hematoma group. Considering the risk of BPB, HB is much safer and can be done easily in Emergency or Out patient department with fewer resources. Singh et al.<sup>11</sup> studied about analgesia for reduction of Colles’ fracture by Double Blind RCT between conventional sedation and HB. They showed that VAS during reduction in HB were acceptably low, that is < 3 (median = 1.8) as compared to the unacceptably high, that is > 3 VAS in the conventionally practiced sedation group (median =8.7), at a very high level of clinical and statistical significance. Therefore they concluded that hematoma block by local anesthesia is a safe and effective alternative to sedation in reduction of Colles’ fractures, recommending the use of HB for the reduction in distal radial fractures.

A review of efficacy and safety of the hematoma block for fracture reduction in closed, isolated fractures has shown VAS of 2.7 and 0.8 for the HB group and Non Hematoma group which is similar to our study.<sup>17</sup>

In Kendell’s study, 72 patients in Bier’s block group and 70 patients in the hematoma block group were included.<sup>18</sup> There was no difference in the pain score on fracture

manipulation as 1.5 in the Bier’s Block group and 2.8 in the Hematoma group which was similar to that observed in our study. (Table 6)

**Table 6: Comparison of VAS in different studies in the Non Hematoma and Hematoma Group**

Studies	Non Hematoma Group VAS	Type of Anesthesia	Hematoma Group VAS
Singh et al <sup>11</sup>	8.7	Sedation (GeneralAnesthesia)	1.8
Furia et al <sup>17</sup>	0.8	Non Hematoma Group	2.7
Kendall et al <sup>18</sup>	1.5	Bier’s Block Group	2.8
Current study	1.7	Brachial Plexus Group	2.08

**The acceptability of reduction in terms of post reduction radiographic configuration**

In the present study, the reduction done under the Hematoma block, have high chance of excellent reduction than the Brachial Plexus block as shown by the post reduction radiograph. In the study done by Kendall et al<sup>18</sup>, more manipulations were required in the hematoma block group (17/70 v 4/72; P=0.003). In terms of radiological reduction the Bier’s Block provide good analgesia for good reduction comparing HB. The perfect reduction provided by Bier’s Block might be concealed due to its risks, requirement of expertise to execute and dreadful complications. Significant reduction of the pain and satisfactory reduction of the fracture in patients undergoing haematoma blocks for Colles’ fractures favors the use of HB as per our study.

A prospective trial to compare hematoma blocks alone and hematoma block with sedation with general anesthesia for the reduction of distal radius fractures in adult patients regarding radiological position after reduction showed that the radiological correction was as good in those patients receiving a hematoma block with or without sedation as in a general anesthesia group. The waiting and manipulation times and resources costs were greater in those receiving a general anesthesia.<sup>16</sup> No difference have been observed in the number requiring re- manipulation between three

methods employed in his study: HB, Bier's Block or general anesthesia, hence concluding that HB is a safe method of reducing Colles' fractures.<sup>3</sup>

### Post reduction complications

In term of complications, we can cautiously and confidently state that HB is much safer than BPB, though there was a huge chance of infection as the closed fractures were converted into grade I open fracture by puncturing the hematoma exactly at the fracture site. To avoid this complication, meticulous aseptic measure was applied using sterile gloves, sterile dressing set and applying antiseptic solution (10% Chohexidine). Despite that risk, our study showed very low incidence of infection as comparable to other studies. While the well known but dreadful respiratory complication occurred in the BPB group, the patient was treated without adverse outcome, thought cost of treatment of complication was much higher than the local infection caused by HB. It was quite remarkable to note that there was no incidence of infection or significant drug toxicity in the Hematoma block group in the study by Singh.<sup>11</sup> Similarly, no complications were associated with HB and Non Hematoma group and Bier Block. Based on these three aspects of study, the hematoma block is an effective and safe method for fracture reduction in closed, isolated fractures in selected patients.<sup>17, 18</sup> No incidence of infection in group, Hematoma block group and Intravenous Regional Anesthesia (IVRA) group was also shown by Johnson PQ.<sup>10</sup> They concluded that if appropriated precautions are taken, HB does not increase the risk of infection. No complications such as vomiting, respiratory depression, a change in the oxygen saturation level, infection, or nerve injury have been observed in 100 children with closed fractures of forearm reduced under Nitrous Oxide combined with HB.<sup>14</sup> In a prospective trial comparing three anesthetic technique used for reduction of fracture distal radius no complications have been observed relates to any of anesthetic methods like HB alone and HB with sedation and general anesthesia.<sup>16</sup> Even though the study was randomized control trial, the low sample size, technical difficulties and constrains in minimizing bias were the limitations of this study.

By discussing and analyzing the study comparing with all the literatures available till date favors the effectiveness and safety of the Hematoma Block in the reduction of the distal forearm fractures. In terms of pain relief, quality of reduction and post reduction complications, it is very feasible in the setting like ours. Therefore "the Hematoma Block" is to be encouraged in our set up for the reduction of the distal forearm fractures. Finally, the technique

developed is of use to surgeons required to reduce the distal forearm fractures especially Colles' fracture in places/countries where scarce anesthesia facilities and resources. The HB is simple and it can be done without major complications as seen in BPB while is highly skilled technique of regional anesthesia.

### Conclusion

HB is simple and it can be done without major complications and may be used in other fractures as well. The study may help in managing such fractures in terms of analgesic and anesthesia techniques like IV sedation, or the BPB, or the Bier's Block, general anesthesia. In term of cost, effectiveness, radiological outcome and complications, fracture load in densely populated developing country and availability of resources and manpower, this technique will be beneficial and easily performed for reduction of such fractures.<sup>3,6,7,8</sup>

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