MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2024.4.357.362

OPEN ACCESS

Key Words
Erector spinae plane block, continuous erector spinae, pain score

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Received: 15 January 2024
Accepted: 22 February 2024
Published: 13 March 2024

Citation: Punith K. Gowda, Vindhya Prasad, Niharika Mustari, Vishwanath S. Bhaire, Mohammad Ali Abu Taha, Gajanan Fultambkar, 2024. A Study Comparing the Efficacy of Single Shot Versus Continuous Infusion in Erector Spinae Plane Block in Spine Surgeries: A Prospective Randomized Control Study . Res. J. Med. Sci., 18: 357-362, doi: 10.59218/makrjms.2024.4.357.362

A Study Comparing the Efficacy of Single Shot Versus Continuous Infusion in Erector Spinae Plane Block in Spine Surgeries: A Prospective Randomized Control Study

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ABSTRACT
Major lumbar spine surgeries cause severe postoperative pain. The aim of this randomized controlled study is to compare analgesic efficacy of single shot versus continuous infusion in erector spinae plane block. After dividing 50 subjects into two groups of 25 each, the surgeries were performed in prone position under general anesthesia. After surgery, Group A (erector spinae plane block-single shot)-patients received 30 ml of 0.2% Ropivacaine and 8mg of dexamethasone (15 ml on each side). Group B (continuous erector spinae block)-patients received a bolus dose of 30ml 0.2% Ropivacaine and 8 mg dexamethasone (15ml each side) followed by bilateral catheter placement which is connected to Inj Ropivacaine 0.2% infusion. Postoperative mean pain score was significantly less in case of continuous erector spinae group as compared to erector spinae plane block group from 6-hour post-surgery till 72 hours post-surgery ($p<0.001$). The number of times the rescue analgesics were given to the patients were significantly less in continuous erector spinae block than erctor spinae plane block ($p<0.01$). The group undergoing continuous erector spinae showed early mobilization as early as post-operative day 1 and helped in early recovery and discharge from hospital. ($p<0.001$).

INTRODUCTION

Optimization of post-operative pain plays an important role in the outcome of spine surgery, permitting early rehabilitation and accelerating functional recuperation. Patient controlled analgesia is prone to opioid related side effects such as nausea, vomiting, ileus, opioid induced hyperalgesia. Furthermore the analgesic effect of post-operative analgesia is limited. If the post-operative pain of lumbar spine surgeries could not be relieved, it may develop into chronic pain, affecting the quality of life of patients[1]. The American Society of Anesthesiologist task force recommend the use of multimodal techniques for pain management. These include regional analgesia, intravenous (IV) and oral analgesics. Opioids, paracetamol and non-steroidal anti-inflammatory drugs have been administered as parenteral analgesics. Opioids can cause nausea, vomiting, pruritus and respiratory depression when they are used solely for analgesia[2].

Regional anaesthesia has advantages than opioid based analgesia, as it provides better pain relief, less nausea and vomiting, early return of bowel function and better abolishment of stress response and thus more controlled hemodynamic parameters. Erector spinae block is a recently described regional anesthesia technique involving local anaesthetic injection into musculofascial plain between erector spinae muscle and tranverse process for providing analgesia by targeting dorsal rami of spinal nerves and thus can provide opioid sparing analgesia for spine surgery. It decreases inhalational anaesthetics and intra operative opioid requirements, enhances recovery from anaesthesia and provides post-operative analgesia[3]. The ultrasound (US)-guided erector spinae plane block (ESPB) was initially described by Forero *et al*. for patients with chronic thoracic neuropathic pain, who were poorly responsive to oral pharmacotherapy providing thoracic analgesia at the T5 transverse process (TP).

Hamilton and Manickam *et al.* reported a successful ESP block using a continuous catheter for pain relief in patients with multiple unilateral rib fractures. Seeing the expanding indications and successful use of ESPB, it was hypothesised by Ashok Jadon et al. that if ESPB is feasible by fluoroscopy, then this block can be used to its full potential where either ultrasound facility is not available or technical know-how is lacking. Moreover, a pain physician who deals with many chronic pain conditions using fluoroscopic guidance will also use it if indication permits[4]. ESPB gained wide attention as it is a faster procedure that carries a lower risk of hypotension, can be used in patients with coagulopathy, is easy to perform, and requires less training. ESPB provides extensive, potent analgesia, is performed by local anesthetic injection in the plane between the erector spinae muscle and the transverse process of vertebra. The local anesthetic diffuses into the para- vertebral space through spaces between adjacent vertebrae and blocks both the dorsal and ventral branches of the thoracic spinal nerves[5,6]. So, the present study has been undertaken as randomized single blind manner to test the efficacy of continuous erector spinae block using catheter vs. erector spinae plane block given single shot in spine surgeries.

MATERIALS AND METHODS

Study Population: ASA Grade I, II and III inpatients posted for elective spine surgery.

Study Design: A prospective double blinded randomized controlled study was conducted on ASA I, II, III patients undergoing lower lumbar spine surgeries under general anaesthesia with bilateral erector spinae block who fulfill inclusion criteria.This study was started after getting institutional ethical committee approval and informed written consent from all the patients undergoing the study.They were randomly divided into 2 groups namely group A and group B.

Group A (erector spinae plane block-single shot)-patients received 30 ml of 0.2% Ropivacaine and 8mg of dexamethasone (15 ml on each side) under fluoroscopy guidance. Group B (continuous erector spinae block)-patients received a bolus dose of 30ml 0.2% Ropivacaine and 8 mg dexamethasone (15ml each side) under fluoroscopy guidance followed by bilateral catheter placement which is connected to Inj Ropivacaine 0.1% infusion.

Sample Size Calculation:

The sample size was calculated using following formula:

n= (Za/2 + Zß)2 (SD)/d2

Solving the Formula:

n= (1.96 + 0.84)2 (120.75) / (6.03)2

We get n= 28 (for each group)

By rounding off, we decided to take 25 cases in each group. Sample Size of Group A-25

Sample Size of Group B-25

Inclusion Criteria:

- Patients scheduled for thoracic and lumbar spine surgeries
- Patients 21-75 years old
- American Society of Anaesthesiologists (ASA) physical status I, II and III 4. BMI 18-35 kg/m2

Exclusion Criteria:

- Patients unable to give consent or inability to communicate/cooperate

- Patients with allergy to local anaesthetics or any drugs included in the study
- Infections at the injection site
- Patients with pre-existing neurological deficits in lower limbs
- Patients with peripheral neuropathy
- Patients with renal Impairment (Creatinine >2.0 mg/dl)
- Patients with liver Impairment
- Patients with spine deformity

Preanaesthetic Evaluation:

- All the patients will undergo thorough pre anaesthetic evaluation prior to surgery
- All systems will be examined including the surface anatomy where the block will be given and the procedure to be carried out will be explained to the patients
- They will be informed about the development of paraesthesia. Patients will be reassured to alleviate their anxieties
- All the patients will be kept nil per oral as per the fasting guidelines
- Written informed consent will be taken

Investigations: The following investigation will be done:

- **Blood investigations:** Hb%, coagulation profile, Urea, Serum creatinine, blood sugar, blood group and cross matching
- **Urine:** Albumin, sugar and microscopy
- ECG and Chest x-ray PA view depending on the age and associated co-Morbidities
- Any other investigations would be done as per the Anaesthetic Requirements only

RESULTS AND DISCUSSIONS

The VAS showed difference in comparison of post-operative pain at 0 hr and 3 hr. The comparison of VAS at 6 hr, 12 hr, 24 hr, 48 hr and 72hr in both the groups using student T test gave a significant p value, hence proving that patients undergoing continuous erector spinae block had better analgesia from 6-72 hrs postoperatively as compared to erctor spinae plane block. In reliability test Cronbach's alpha is 0.859 means it is having 85 per cent of the internal consistency among the 7 questions of the scale in this items (minimum is 0.70 or 70%) and it means 85 per cent of the variance in the scores is reliable variance and only 15% per cent is error variance. Using a ANOVA (F-test) test which is tested at 0.05 level (5% Level) it is found that are significant at 0.01 (1%) and 0.05 (5%) level, so the overall model of the VAS 10 point scale and time period (in Hrs) having significant changes (Table 20 .a). In reliability test Cronbachs' alpha is 0.921 means it is having 92% of the internal consistency among the 5 questions of the scale in this items (minimum is 0.70 or 70%) and it means 92 percent of the variance in the scores is reliable variance and only 8% per cent is error variance. Using a Chi-Square test which is tested at 0.05 level (5% Level) and 0.01 (1% level) it is found that are significant, so, there are associations between VAS 10 point scale and time period (in Hrs) (Table 20.a). Chin. K.J, Suarez. et al.[7] revealed ESP block can provide abdominal analgesia if performed at lower thoracic levels because the erector spinae muscles extend to the lumbar spine. catheter inserted into this

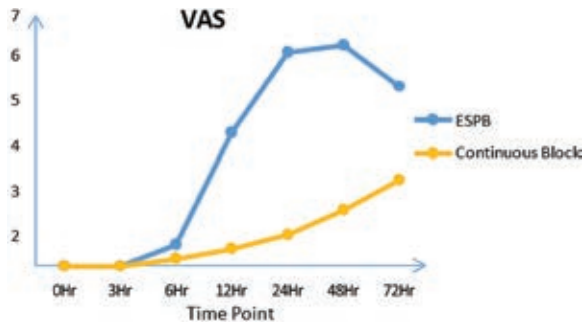

Fig. 1: Comparison of visual analog scale (vas) at different time in both study groups

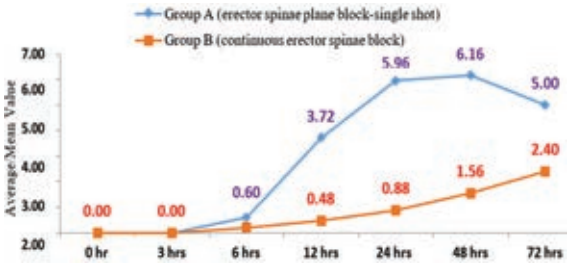

Fig. 2: Mean or Average VAS 10 Point Scale with Different Time Period (in Hrs) and Group A and B Patients

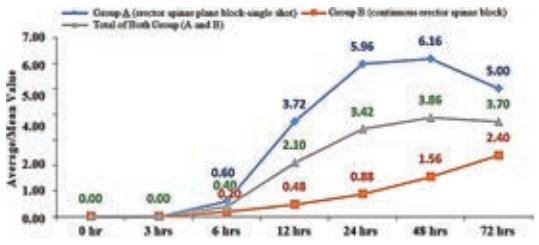

Fig. 3: Mean or Average VAS 10 Point Scale with Different Time Period (in Hrs) and Group A, B and Both Patients

Table 1: Cmparison of visual analog scale (vas) at different time in both study groups

	Group		
VAS	**ESPB**	**Continuous Block**	**p-value**
0Hr	0 ± 0	0±0	NA
3Hr	0±0	0±0	NA
6Hr	0.6±0.816	0.2±0.408	0.033
12Hr	3.72±0.678	0.48±0.714	<0.001
24Hr	5.96±0.539	0.88±0.726	<0.001
48Hr	6.16±0.374	1.56±0.507	<0.001
72Hr	5±0	2.4±0.5	<0.001

Table 2: Mean or Average VAS 10 Point Scale with Different Time Period (in Hrs)

Mean-VAS 10 Point Scale

Group	0 hr	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs
Group A (erector spinae plane block-single shot)	0.00	0.00	0.60	3.72	5.96	6.16	5.00
Group B (continuous erector spinae block)	0.00	0.00	0.20	0.48	0.88	1.56	2.40
Total of Both Group (A and B)	0.00	0.00	0.40	2.10	3.42	3.86	3.70

Table 3: Reliability Test and ANOVA Test for VAS 10 Point Scale

Case Processing Summary		N	Percentage
Cases	Valid	50	100.0
	Excludeda	0	0.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.859	**7**

Item Statistics

VAS 10 Point Scale	Mean	Std. Deviation	N
0 hr	0.00	0.000	50
3 hrs	0.00	0.000	50
6 hrs	0.40	0.670	50
12 hrs	2.10	1.776	50
24 hrs	3.42	2.643	50
48 hrs	3.86	2.365	50
72 hrs	3.70	1.359	50

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
13.48	**68.418**	**8.272**	**7**

ANOVA		Sum of Squares	Df	Mean Square	F	Sig
Between People		478.926	49	9.774		
Within People	Between Items	944.869	6	157.478	114.523	0.000
	Residual	404.274	294	1.375		
	Total	1349.143	300	4.497		
Total		1828.069	349	5.238		
		Grand Mean = 1.93				

Note: Significant at the 0.01 (1%) level and 0.05 level (5%).

Table 3a: Reliability Test and Chi-Square Test for VAS 10 Point Scale of over all 50 Patients

Case Processing Summary		N	parentage
Cases	Valid	50	100.0
	Excludeda	0	0.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Result of Reliability Statistics of Cronbach's Alpha Test

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
0.921	0.925	5

Result of Friedman's Chi-Square Test

ANOVA with Friedman's Test		Sum of Squares	df	Mean Square	Friedman's Chi-Square	Sig
Between People		670.496	49	13.684		
Within People	Between Items	425.696a	4	106.424	133.363	0.000**
	Residual	212.704	196	1.085		
	Total	638.400	200	3.192		
Total		1308.896	249	5.257		
		Grand Mean = 2.70				
		a. Kendall's coefficient of concordance W = .325.				

Note: Significant at the 0.01 (1%) level and 0.05 level (5%).

Table 4: t-Test of One-Sample Statistics for VAS 10 Point Scale for over all 50 Patients or Both A and B Group Patients

One-Sample Statistics

VAS 10 Point Scale	N	Mean	Std. Deviation	Std. Error Mean
0 hr	50	0.000	0.000a	0.000
3 hrs	50	0.000	0.000a	0.000
6 hrs	50	0.400	0.670	0.095
12 hrs	50	2.100	1.776	0.251
24 hrs	50	3.420	2.643	0.374
48 hrs	50	3.860	2.365	0.334
72 hrs	50	3.700	1.359	0.192

Note: a. t cannot be computed because the standard deviation is 0.

Result of One-Sample Test

One-Sample Test

	Test Value = 0			
VAS 10 Point Scale	t	df	Sig. (2-tailed)	Mean Difference
6 hrs	4.221	49	0.000**	0.400
12 hrs	8.363	49	0.000**	2.100
24 hrs	9.151	49	0.000**	3.420
48 hrs	11.542	49	0.000**	3.860
72 hrs	19.251	49	0.000**	3.700

plane can extend analgesic duration and can be an alternative to epidermal analgesia. They describe using bilateral ESP catheters inserted at the T8 level to provide intense preoperative analgesia for major open lower abdominal surgery. uan Carlos Luis-Navarro, María Seda-Guzm[8] experienced with unilateral ESP blockade during laparoscopic nephrectomy shows a higher rate of success and nil complications related to either catheter placement or continuous administration of local anaesthetic. Intraoperative use reduces the need for intravenous analgesics during surgery. This discovery encourages us to continue to use ESP block as the first-line analgesia as a part of multi modal analgesia, replacing the use of the epidural catheter. Gürkan *et al.*[9] evaluated the ESP block for postoperative analgesia in breast surgery. They compared 50 patients in two groups (ESP group and control group). Total morphine consumption in block group decreased by 65% at 24 h compared to the control group (5.76 ± 3.80 mg vs. 16.60 ± 6.92 mg), but there was no statistically significant difference between the groups in terms of NRS scores. ksuz *et al.*[10] also compared the bilateral ESP block with tumescent anesthesia for postoperative analgesia in 43 patients undergoing reduction mammoplasty. The NRS scores and the requirement for additional analgesia were statistically significantly lower in the ESP group.

Altiparmak *et al*. [11] compared the effects of modified pectoral nerve (PECS) block and ESP block after radical mastectomy surgery. They concluded that PECS block reduced postoperative tramadol consumption (132.78±22.44 mg vs. 196.00±27.03 mg) and NRS scores after the postoperative 1 h, 2 h, 12 h, and 24 h more effectively than the ESP block. Robert Owen *et al.* [12] described that ESP blocks are well suited to become a useful tool for improving patient pain control and function and for limiting opioid use following lumbar spine surgery. ESP blocks delivered via a novel fluoroscopic technique significantly reduce postoperative opioid use following lumbar fusions. Block patients ambulate ealy and have reduced length of stay.

CONCLUSION

Bilateral continuous erector spinae block is efficacious alternative in providing post-operative pain management in lumbar spine surgeries.

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