# Perioperative analgesic efficacy of Ultrasound guided Erector spinae plane block (ESPB) in adult patients undergoing lumbar spine surgery

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***Received Date: 12/03/2023 Revised Date: 19/04/2023 Published Date: 10/05/2023***

**ABSTRACT**

**Background:** Postoperative pain relief is crucial to ensure patient comfort, make early mobilization possible and hasten recovery. Perioperative morbidity can be efficaciously reduced with good postoperative pain management. Lumbar spine surgery in particular is frequently associated with severe postoperative pain. Erector Spinae Plane Block (ESPB), a new truncal fascial block technique was introduced to target the posterior root of the spinal nerve. **Methodology-** A Randomized double blind controlled study conducted at tertiary care centre involving 80 patients who were scheduled to undergo lumbar spine surgery satisfying inclusion criteria were included in the study. With the help of the SNOSE technique, patients were randomly assigned into two equal groups. The ESP group received ESPB with 20 ml of 0.25% bupivacaine which was injected under USG guidance on both sides while the group C did not receive erector spinae block. **Results-** Mean time for first rescue analgesia in Erector spinae plane block group was 7.73 ± 0.87 hours and in the control group it was 6.10 ± 2.274. There was significant difference in time for first rescue analgesia between the groups. In ESPB group, 10% required additional rescue analgesia and in control group 27.5% required additional rescue analgesia. **Conclusion-** ESPB block has also proven to provide good pain relief until the first 6 hours post-surgery with significantly lower VAS scores.

**Keywords:** ESPB, spine surgery, perioperative, bilateral, Ultrasound

**Introduction:** Major spine surgery is recognized to be associated with the occurrence of significant postoperative pain. Lumbar spine surgery in particular is frequently associated with severe postoperative pain. Patient recovery is accelerated by early mobilization which is often restricted by postoperative pain.[1-2] Conventional postoperative analgesics have a limited effect in relieving pain associated with lumbar spine surgeries. Persistent postoperative pain may evolve into chronic debilitative pain, which negatively impacts the quality of life.[3]
In 2016[4] a new truncal fascial block technique was postulated to target the posterior root of the spinal nerve, described as the Erector Spinae Plane Block (ESPB). It has been theorized that as drug solution diffuses, it causes ESPB to produce a partial para_spinal block phenomenon due to blockade of spinal nerve`s posterior root.[5-6] ESPB has been implemented for postoperative analgesia in thoracic and abdominal surgeries. Additionally, it was found that ESPB may contribute to a reduction in the use of perioperative muscle relaxants and analgesic drugs. The application of ESPB has been found to be effective in several surgeries including breast surgery[7] and bariatric surgeries.[8] It is speculated that he efficacy of ESPB may be better than that of the conventional epidural injection in providing postoperative analgesia.[9]
With the above knowledge and the paucity of existing literature, the study was conducted to find out the perioperative analgesic efficacy ultra sound guided bilateral ESPB in adult patients undergoing lumbar spine surgery.

**Materials And Methods**
**Study Place:** Patients of ASA Physical status I-II scheduled to undergo single- or two-level lumbar spine surgeries under general anaesthesia, at JSS Hospital, Mysuru.
**Study Design:** Randomized Double Blind Controlled Trial. With the help of the SNOSE technique, patients were randomly assigned into two equal groups:
Erector spinae plane block (ESP) group.
Control (C) group.
All study patients received standard general anaesthetics care including premedication with inj. midazolam 0.02mg/kg, inj. fentanyl 1mcg/kg and induction with inj. propofol 2mg/kg and inj. vecuronium 0.1mg/kg as muscle relaxant and intubated with an appropriate sized endotracheal tube and maintained with isoflurane: $N_2O$:$O_2$ = 1-1.2 %: 3: 2 and inj. vecuronium as required. The ESP group received ESPB with 20 ml of 0.25% bupivacaine which was injected under USG guidance on both sides while the group C did not receive erector spinae block.
**Inclusion criteria:** Patients aged between 18-60 years, having ASA Physical status I-II, Body Mass Index 18.5 – 30 kg/m2, having weight >50kg, and duration of surgery < 3 hours.
**Exclusion criteria:** Patient refusing for giving consent, Patient with history of allergy or contraindication to the study drugs, with history of bleeding or coagulation disorders, history of severe heart, kidney, liver or haematological disorders.
**Sample size:** A sample size was derived using sampling technique, by using the following formula:

$$N = \frac{2S_p^2\left[Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right]^2}{\mu_\beta^2}$$

$$S_p^2 = \frac{S_1^2 + S_2^2}{2}$$

$S_1^2$ = S.D in the first group
$S_2^2$ = S.D in the second group
$\mu_\beta^2$ = Mean difference between the samples

$\alpha$ = significance levels
$1 - \beta$ = Power
$Z_{1-\alpha}\ (for\ 90\%\ power) = 1.96$
$Z_{1-\beta} = 1.24$
$S_p^2 = \frac{(40)^2 + (40)^2}{2} = 1600$
$2\,N = \frac{2 \times 1600\ [\ 1.96 + 1.24\ ]^2}{(3)^2} = 36.40 \sim 37$

Considering the effect size as 0.75 (analgesic dose of tramadol 100mg in group C, 70mg in ESP group and 30% reduction in dose of analgesics and SD in each group as 40 mg), Alpha error of 5%, Power of 90%, the sample size calculated was 37 in each group.
Considering dropouts, the **sample size** in each group included were 40.
**Data analysis:** Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions.
**Ethical considerations:** This study has been approved by the Institutional Ethical Committee of the hospital. Written informed consent was taken from the patients. Confidentiality of the patients was maintained.

## Results

**Table 1:** Age distribution comparison between two groups

| **Age** | **Group** | | | |
|---|---|---|---|---|
| | **Erector spinae plane block group** | | **Control group** | |
| | **patients** | **%** | **patients** | **%** |
| 21 to 30 years | 4 | 10.0% | 6 | 15.0% |
| 31 to 40 years | 14 | 35.0% | 6 | 15.0% |
| 41 to 50 years | 6 | 15.0% | 9 | 22.5% |
| >50 years | 16 | 40.0% | 19 | 47.5% |
| **Total** | 40 | 100.0% | 40 | 100.0% |

$\chi$ 2 =4.457, df =3, p =0.216 **[Chi-square test]**
In the Erector spinae plane block group, 40% were in the age group >50 years and in control group, majority of subjects were in the age group >50 years (47.5%). There was no significant difference in age distribution between two groups.

**Table 2:** Mean Age distribution comparison between two groups

| **Age (Years)** | **N** | **Mean** | **SD** | **95% Confidence Interval for Mean** | | **Minimum** | **Maximum** | **P value** |
|---|---|---|---|---|---|---|---|---|
| | | | | **Lower Bound** | **Upper Bound** | | | |
| Erector spinae plane block group | 40 | 45.20 | 11.541 | 41.51 | 48.89 | 21 | 63 | 0.665 |
| Control group | 40 | 46.33 | 11.636 | 42.60 | 50.05 | 21 | 60 | |
| **Total** | 80 | 45.76 | 11.529 | 43.20 | 48.33 | 21 | 63 | |

**Independent t test**

Mean age of subjects in Erector spinae plane block group was 45.20 ± 11.541 years and in control group was 46.33 ± 11.63 years. There was no significant difference in age group between two groups.

**Table 3:** Duration of Surgery comparison between two groups

| Time for First Rescue Analgesia (Hours) | N | Mean | SD | 95% Confidence Interval for Mean | | Minimum | Maximum | P value |
|---|---|---|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound | | | |
| Erector spinae plane block group | 40 | 133.50 | 31.178 | 123.53 | 143.47 | 60 | 180 | 0.071 |
| Control group | 40 | 122.25 | 23.148 | 114.85 | 129.65 | 60 | 180 | |
| Total | 80 | 127.88 | 27.865 | 121.67 | 134.08 | 60 | 180 | |

**Independent t test**

Mean duration of surgery in Erector spinae plane block group was 133.50 ± 31.17 min and in Control group was 122.25 ± 23.148 min. There was no significant difference in mean Duration of Surgery between two groups.

**Table 4:** ASA Grade comparison between two groups

| | | Group | | | |
|---|---|---|---|---|---|
| | | Erector spinae plane block group | | Control group | |
| | | Patients | % | Patients | % |
| ASA Grade | I | 24 | 60.0% | 22 | 55.0% |
| | II | 16 | 40.0% | 18 | 45.0% |
| | **Total** | 40 | 100.0% | 40 | 100.0% |

$\chi 2 = 0.205$, df =1, p = 0.651 **[Chi-square test]**

In the Erector spinae plane block group, 60% had ASA grade I and 40% had ASA Grade II. In Control group, 55% had ASA grade I and 45% had ASA Grade II. There was no significant difference in ASA Grade between two groups.

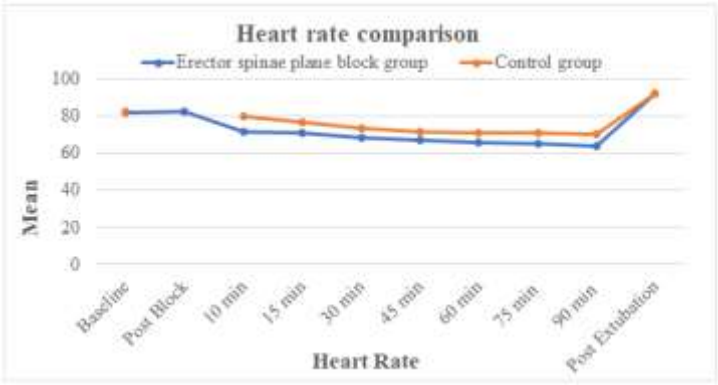


**Figure 1:** Line diagram showing Heart rate comparison between two groups

**Independent t test**

In the study at baseline there was no significant difference in Heart rate between two groups. However, there was significant difference in mean Heart rate at 10 min, 15 min, 60 min, 75 min and 90 min between two groups. At these intervals mean Heart rate was lower in Erector spinae plane block group. At other intervals there was no significant difference in Heart rate between two groups.

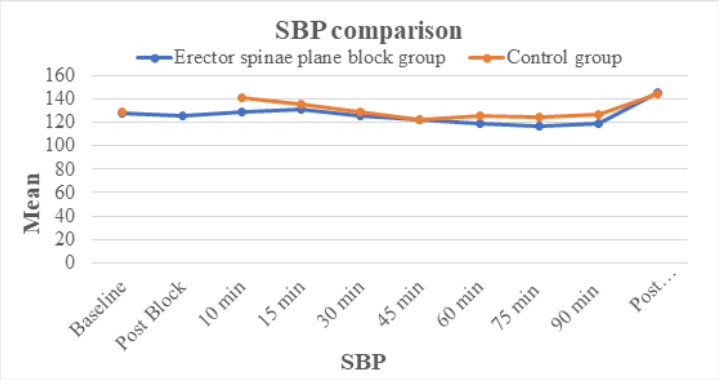


**Figure 2:** Line diagram showing SBP comparison between two groups at different periods of follow-up

**Independent t test**

In the study at baseline there was no significant difference in SBP between two groups. However, there was significant difference in mean SBP at 10 min, 60 min, 75 min and 90 min between two groups. At these intervals mean SBP was lower in Erector spinae plane block group. At other intervals there was no significant difference in SBP between two groups.

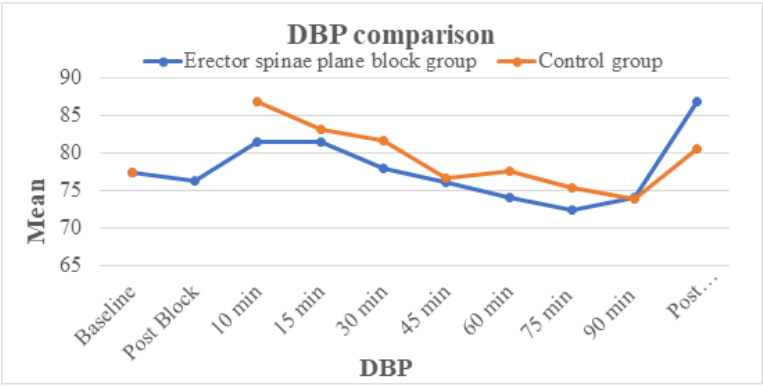


**Figure 3:** Line diagram showing DBP comparison between two groups at different periods of follow-up

There was no significant variance in DBP between both groups at baseline. Also, there was no difference in mean DBP when compared ESP group to control group during intra-operative period

**Table 5:** MAP comparison between two groups at different periods of follow-up

| MAP | Group | | | | | | P value |
|---|---|---|---|---|---|---|---|
| | Erector spinae plane block group | | | Control group | | | |
| | Mean | SD | Median | Mean | SD | Median | |
| Baseline | 93.85 | 7.64 | 95 | 95.10 | 6.63 | 94 | 0.437 |
| Post Block | 92.73 | 6.30 | 94 | . | . | . | - |
| 10 min | 98.93 | 14.65 | 95 | 102.05 | 16.36 | 100 | 0.371 |
| 15 min | 97.50 | 11.81 | 97 | 101.40 | 16.65 | 98 | 0.230 |
| 30 min | 93.75 | 10.56 | 94 | 98.03 | 12.94 | 97 | 0.110 |
| 45 min | 91.30 | 10.34 | 92 | 91.70 | 12.54 | 89 | 0.877 |
| 60 min | 88.48 | 7.23 | 88 | 94.13 | 10.90 | 91 | 0.008* |
| 75 min | 87.58 | 7.97 | 87 | 91.78 | 9.90 | 89 | 0.04* |
| 90 min | 89.17 | 8.97 | 89 | 91.30 | 10.96 | 90 | 0.346 |
| Post Extubation | 105.40 | 6.52 | 105 | 104.10 | 10.04 | 105 | 0.346 |

**Independent t test**

In the study at baseline there was no significant difference in MAP between two groups. However, there was significant difference in mean MAP at 60 min and 75 min between two groups. At these intervals mean MAP was lower in Erector spinae plane block group between two groups. At other intervals there was no significant difference in MAP between two groups.

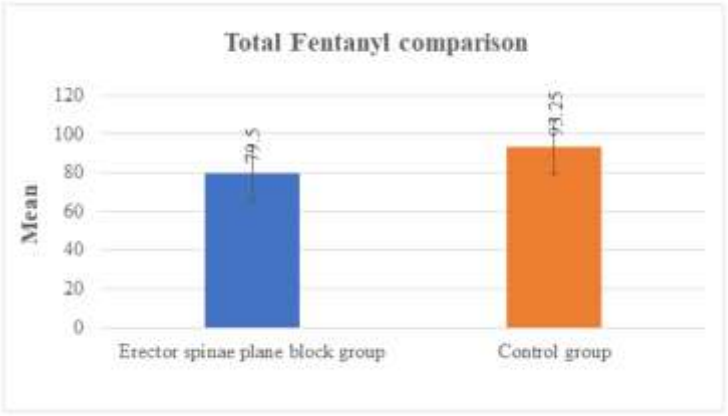


**Figure 4:** Bar diagram showing Total Fentanyl comparison between two groups

**Independent t test**

Mean Total Fentanyl required in Erector spinae plane block group was 79.50 ± 14.31 mcg and in Control group was 93.25 ± 14.21 mcg. There was significant difference in total Fentanyl required between two groups.

**Table 6:** Time for First Rescue Analgesia comparison between two groups

| Time for First Rescue Analgesia (Hours) | N | Mean | SD | 95% Confidence Interval for Mean | | Minimum | Maximum | P value |
|---|---|---|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound | | | |
| Erector spinae plane block group | 40 | 7.73 | 0.877 | 7.44 | 8.01 | 6 | 9 | <0.001* |
| Control group | 40 | 6.10 | 2.274 | 5.37 | 6.83 | 1 | 8 | |
| Total | 80 | 6.91 | 1.897 | 6.49 | 7.33 | 1 | 9 | |

**Independent t test**

Mean Time for First Rescue Analgesia in Erector spinae plane block group was 7.73 ± 0.87 Hours and in Control group it was 6.10 ± 2.274. There was significant difference in time for first rescue analgesia between two groups.

**Table 7:** Additional Rescue Analgesia Required comparison between two groups

| | | Group | | | |
|---|---|---|---|---|---|
| | | Erector spinae plane block group | | Control group | |
| | | Count | % | Count | % |
| **Additional Rescue Analgesia Required** | No | 36 | 90.0% | 29 | 72.5% |
| | Yes | 4 | 10.0% | 11 | 27.5% |
| | Total | 40 | 100.0% | 40 | 100.0% |

$\chi 2 = 4.021$, df =1, p =0.045* **[Chi-square test]**

In Erector spinae plane block group, 10% required Additional Rescue Analgesia and in Control group, 27.5% required Additional Rescue Analgesia. There was significant difference in Additional Rescue Analgesia Required between two groups.

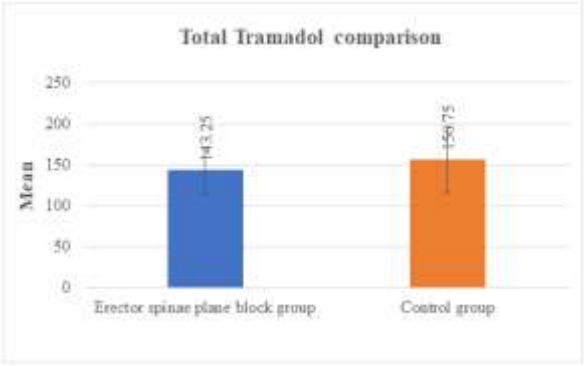


**Figure 5:** Bar diagram showing Total Tramadol comparison between two groups

**Independent t test**

Mean Total Tramadol required in Erector spinae plane block group was 143.25 ± 28.679 mg and in Control group was 156.75 ± 40.248 mg. There was no significant difference in total Tramadol consumption between two groups in first 24 hours post-operative period.

**Discussion**

In this study, the mean age of subjects in the Erector spinae plane block group was 45.20 ± 11.541 years and in the control group was 46.33 ± 11.63 years(P=0.665). In the Erector spinae plane block group, 40% were in the age group >50 years while in the control group, 47.5% were in the age group >50 years (47.5%). The majority of subjects were in the age group >50 years. No significant difference was observed between the control and ESP groups in terms of age distribution. The mean duration of surgery in the ESP group was 133.50 ± 31.17 min and in the control group was 122.25 ± 23.148 min.(P=0.071) No significant difference was observed in the mean duration of surgery between the control and ESP groups. In the Erector spinae plane block group, 60% were ASA grade I and 40% were ASA Grade II. In the Control group, 55% were ASA grade I and 45% were ASA Grade II. (P=0.651) There was no significant difference in the ASA grades between the two groups.

In this study, at baseline (P=0.930) no significant variation in Heart rate in between the ESP and control groups.

However, we observed a significant difference in mean Heart rate at 10 min, 15 min, 60 min, 75 min and 90 min between the two groups. At these intervals mean Heart rate was lower in the ESP group. At other intervals no significant difference in Heart rate was observed between the both groups. At baseline, no significant difference in SBP was seen between the two groups. Furthermore, no significant difference in mean SBP between the two groups during intraoperative period. There was no significant variance in DBP between both groups at baseline. Also, there was no difference in mean DBP when compared ESP group to control group during intra-operative period. The MAP of the two groups at baseline showed no statistically significant variation in this study. However, there was a significant difference in mean MAP at 60 min and 75 min between the two groups. At these intervals mean MAP was lower in the Erector spinae plane block group when compared to the control group.

Our study found that there was a significant difference in heart rate in the ESP group during intra-operative period when compared to group C. These results are similar to a study conducted by Yanwu Jin[10] where they found out that heart rate change ($\triangle$ HR= 3.000±3.000) in control group was higher than that of the ESP Group significantly in which heart rate

change(▵HR=1.500±2.750) with (P▵HR=0.003). Our results are also similar to the study conducted by Ezzzt M. Siam[11], where they found that in the ESP group mean heart rate was (79.20 ± 12.46) bpm after stimulation and (74.0 ± 8.79) bpm during the 1st time interval respectively, in the control group, at the same time interval periods the mean heart rate was (88.07 ± 10.22) and (81.00 ± 8.03) bpm. Statistically significant differences were observed between both the groups after stimulation and at the 1st time interval (p values 0.042, 0.031) respectively. This study found that no significant difference in SBP and DBP between ESP group and group C during the intraoperative period but there was a significant dissimilarity in MAP between both groups at 60 mins and at 75 mins but not observed at the other time intervals. At the mentioned intervals, the mean MAP was lower in the ESP group when compared to Control group. These results are dissimilar to the results in the study done by Yanwu Jin[10] where they found that there was no significant difference in SBP between the ESP group and the Control group but there was a significant difference in DBP variation (▵DBP= 6.000±4.000) in control group and it was significantly more than that of ESP Group where DBP variation was (▵DBP= 3.500±3.000). Our results are also dissimilar to the results in the study done by Ezzzt M. Siam[11] where they observed there was a significant variation in SBP and DBP during the intraoperative period.

In our study, we observed that the Mean time for first rescue analgesia in the Control group was 7.73 ± 0.87 hours which was significantly longer when compared to the ESP group which was 6.10 ± 2. 274 hours. A total of 4 patients (10%) in the ESP group received rescue analgesia and in the control group a total of 11 patients (27.5%) received rescue analgesia which was statistically significant(P=0.045). The results of the study conducted by Ahmer Murat Yayik et. al[12] found that in the ESPB group the time of first analgesia requirement was 325.17 ±22.82 minutes which was significantly longer when compared to control group which was 174.17 ± 22.82 minutes. Our study also showed similar results to those of the study conducted by Ezzzt M. Siam et al[11] where they observed that mean time for first analgesia requirement in the control group was 172.0 ± 198.83 mins which was significantly longer when compared to the ESPB group which was 112.0 ± 59.43 mins.

In our study, we observed that the Mean total Fentanyl used in the Control group was 93.25mcg±14.21 which was significantly higher statistically but not clinically when compared to the ESPB group which was 79.50mcg±14.31 with a P value of <0.001. Our study results were similar to those of the study conducted by Ezzzt M. Siam et al[11] where they observed that the Mean fentanyl requirement in the ESP group was 10 ± 28.03 mcg which was found to be significantly lower than in Control group patients which was 46.67 ± 48.06mcg (P= 0.049). In our study, the mean total tramadol used in the first 24 hours in PACU in the Control group was 156.75±40.24mg, which was not significantly higher when compared to those of the ESP group, whose mean total tramadol used was 143.25 ±28.67 (P=0.088).These results differ from those of the previous study done by Ahmet Murat Yayik et al.[12]

## Conclusion

It can be concluded that ESP block is effective in reducing the intraoperative analgesic requirement and in maintenance of haemodynamic stability during the intraoperative period. ESPB block can also delay the requirement of first rescue analgesia in the PACU. However, the effect of ESP block is negligible beyond 6 hours post-surgery. The total tramadol usage during first 24 hours is not impacted by the administration of the ESP block.

Hence, ESPB block can be administered in patients undergoing lumbar spine surgeries to ensure better intraoperative haemodynamic stability and better postoperative analgesia in the first 6 hours but must still be supplemented with conventional analgesia to ensure adequate pain relief in the postoperative period.

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