



ASSESSMENT AND COMPARATIVE STUDY ON ULTRASOUND GUIDED BILATERAL ERECTOR SPINAE PLANE BLOCK VS CAUDAL EPIDURAL BLOCK FOR PERI-OPERATIVE ANALGESIA IN LUMBAR SPINE FUSION SURGERIES.

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Abstract

BACKGROUND: Lumbar canal stenosis surgeries are associated with significant postoperative pain, necessitating effective analgesia for enhanced recovery and early mobilization. Regional anesthesia techniques such as ultrasound-guided caudal epidural block (US-CEB) have been traditionally used, but newer techniques like the ultrasound-guided erector spinae plane (ESP) block offer promising results. The ESP block, due to its anatomical spread and ease of application, may provide superior perioperative analgesia and reduce opioid requirements.

AIM : To compare the perioperative analgesic efficacy of ultrasound-guided bilateral erector spinae plane block versus caudal epidural block in lumbar canal stenosis surgeries, focusing on hemodynamic stability and postoperative opioid consumption.

METHODS: This **observational study** was conducted on **106 patients** scheduled for elective lumbar canal stenosis surgery under general anesthesia were assessed for eligibility. Patients meeting the inclusion criteria were **randomly allocated into two groups (n = 25 each)** using a computer-generated randomization table.

- **Group E (n = 25):** Received **ultrasound-guided bilateral erector spinae plane (ESP) block** using **20 mL of 0.25% levobupivacaine** on each side.

- **Group C (n = 25):** Received **ultrasound-guided caudal epidural block** with **20 mL of 0.25% levobupivacaine**.

All patients underwent surgery under standardized general anesthesia protocols. Intraoperative monitoring included heart rate (HR), mean arterial pressure (MAP), and blood pressure (BP). Postoperative pain was assessed using the Visual Analogue Scale (VAS) and Dynamic VAS (D-VAS) at intervals of **15 minutes, 2, 4, 6, and 24 hours**. The time to first analgesic request and total postoperative opioid consumption were recorded.

RESULTS The time for 1st analgesia request in Group A - (ESP block) was found to be 11.2 ± 2.607 & In Group-B (Caudal epidural) was found to be 3.37 ± 1.280 hours (p value < 0.0001)

CONCLUSION: Bilateral US-ESP appears to be effective technique for delivering appropriate intraoperative & postoperative analgesia in lumbar spine surgeries. There is a significant reduction in opioid consumption in ESP group compared to US-CEB group

INTRODUCTION:

Intense pain is often experienced following spinal surgeries, particularly in the first few days. It has been seen that early ambulation, early discharge, better functional result, and reducing the development of chronic pain are all positively correlated with adequate pain treatment during this time.

The activation of nociceptive, neuropathic, and inflammatory pain mechanisms results in postoperative pain.² Many tissues, including the vertebrae, intervertebral discs, ligaments, dura, nerve root sleeves, facet joint capsules, fascia, and muscles, can cause back pain. These sensations are transmitted by a variety of nociceptors and mechanoreceptors that are able to cause pain. The posterior rami of spinal nerves that are associated with the sympathetic and parasympathetic nervous systems innervate these tissues. Pain is brought on by mechanical irritation, compression, or surgical inflammation. Referred pain is common because these nerves have significant cross-connectivity. Patients undergoing spine procedures are receiving opioids, non-opioid medications, regional and neuraxial methods, as well as ketamine and lidocaine infusions.

Opioids are mainstay treatment for patients undergoing spine surgery. Nonsteroidal anti-inflammatory drugs, Acetaminophen (intravenous or oral), Gabapentin or pregabalin are the non opioid options. Ketamine at a dose of 0.1–0.5mg/kg bolus followed by infusion of 0.1–0.6 mg/kg/h intraoperatively and subanaesthetic infusion of 0.1–1 mg/kg/h postoperatively can be given. Lidocaine infusion can be given at a dose of 1 mg/kg/h based on adjusted body weight. Local anesthetic wound infiltration or catheter, spinal anesthesia, epidural analgesia or combined spinal-epidural anesthesia are other options. Thoracolumbar interfascial block and Erector spinae plane block are few of the latest techniques.

The Erector spinae plane (ESP) block is being widely used as an analgesic option for various surgeries. Forero et al. first presented the method in 2016 as a means of treating thoracic neuropathic pain. In our study, erector spinae plane block is being compared to local infiltration of anaesthetic for lumbar spine fusion surgeries.

The caudal epidural block is a well-established regional anesthesia technique, commonly used for providing perioperative analgesia in lower limb, perineal, and lumbar surgeries. It involves the injection of local anesthetic into the epidural space via the sacral hiatus, resulting in blockade of sacral and lower lumbar nerve roots. With ultrasound guidance, the accuracy and success rate of caudal blocks have significantly improved, minimizing complications. Despite its widespread use, limitations include variable spread of anesthetic, shorter duration of action, and reduced efficacy in adults compared to newer fascial plane blocks.

MATERIALS AND METHODS

The **observational study** was conducted at **Narayana Medical College** over a period of **six months (January 2024 – June 2024)** after obtaining approval from the Institutional Ethics Committee. **Written informed consent** was obtained from all participants prior to enrollment.

SAMPLE SIZE

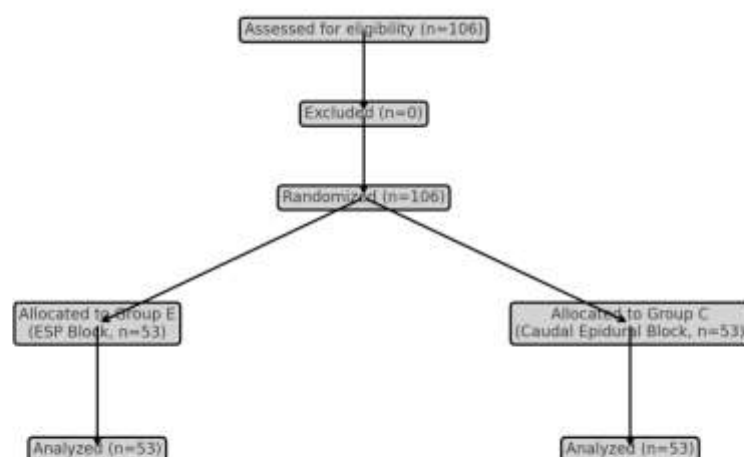
According to previous study, time to first analgesic requirement (hrs) in caudal epidural group was 2.93 ± 2.70 . With an expected minimum difference of 50% between groups with a 95% confidence level and 80% power, each group's anticipated sample size is 53 in each group.

$$n_1 = \frac{(\sigma_1^2 + \sigma_2^2 / \kappa)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

$$n_2 = \frac{(\kappa * \sigma_1^2 + \sigma_2^2)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

A total of **106 patients** scheduled for elective lumbar canal stenosis surgery under general anesthesia were assessed for eligibility. Patients meeting the inclusion criteria were **randomly allocated into two groups (n = 25 each)** using a computer-generated randomization table.

CONSORT DIAGRAM



INCLUSION CRITERIA

1. Age between 18–60 years
2. Either gender
3. American Society of Anesthesiologists (ASA) physical status I or II

EXCLUSION CRITERIA

1. Patient refusal
2. ASA physical status III and IV
3. Known allergy to local anesthetics
4. Local skin infections at the block site

5. Coagulopathy or current use of anticoagulants

GROUP ALLOCATION

- **Group E (n = 25):** Received **ultrasound-guided bilateral erector spinae plane (ESP) block** using **20 mL of 0.25% levobupivacaine** on each side.
- **Group C (n = 25):** Received **ultrasound-guided caudal epidural block** with **20 mL of 0.25% levobupivacaine**.

All patients underwent surgery under standardized general anesthesia protocols. Intraoperative monitoring included heart rate (HR), mean arterial pressure (MAP), and blood pressure (BP). Postoperative pain was assessed using the Visual Analogue Scale (VAS) and Dynamic VAS (D-VAS) at intervals of **15 minutes, 2, 4, 6, and 24 hours**. The time to first analgesic request and total postoperative opioid consumption were recorded.

METHODOLOGY

GROUP E (ESPB group) : The ultrasound-guided erector spinae plane (ESP) block is performed with the patient in a prone position. Under aseptic precautions, a high-frequency linear or low-frequency curvilinear ultrasound probe is placed in a longitudinal parasagittal orientation 2–3 cm lateral to the spinous process at the desired vertebral level (usually at L3 or L4 for lumbar surgeries).

The transverse process and overlying erector spinae muscle are identified. A block needle 22G is inserted in-plane in a cranial-to-caudal or caudal-to-cranial direction until the tip contacts the bony surface of the transverse process. After negative aspiration, **20 mL of 0.25% levobupivacaine** is injected deep to the erector spinae muscle but superficial to the transverse process. The injectate spreads cranio-caudally in the fascial plane, targeting the dorsal and ventral rami of the spinal nerves.

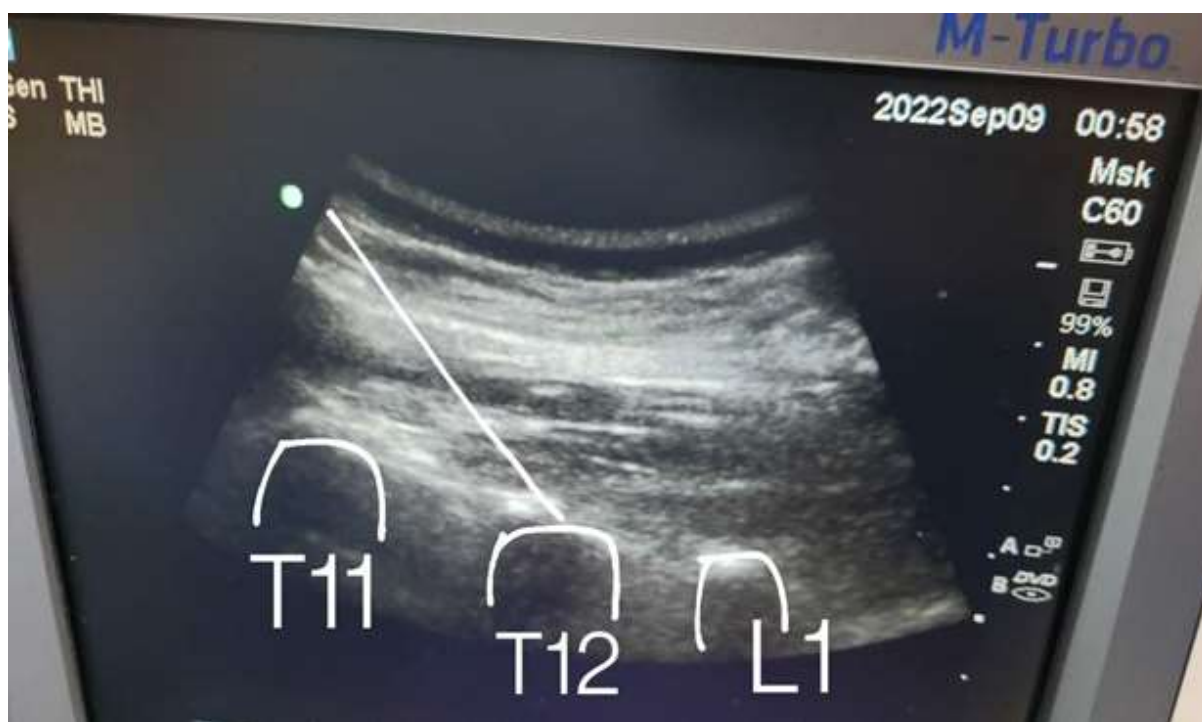


Figure 1

GROUP C (CEPB group) : The **caudal epidural block** is performed with the patient in the **prone or lateral decubitus position**, with a pillow placed under the pelvis to facilitate access to the sacral hiatus. Under strict aseptic precautions, the **sacral hiatus** is palpated between the sacral cornua at the lower end of the sacrum.

A **high-frequency linear ultrasound probe** is placed in the **transverse or longitudinal orientation** over the sacral hiatus to visualize key anatomical landmarks: the **sacroccygeal ligament**, **sacral cornua**, and **sacral canal**.

A **22G needle** is inserted at a 30–45° angle through the sacroccygeal ligament under **real-time ultrasound guidance**. Correct needle placement is confirmed by visualization of the needle entering the caudal epidural space, and **negative aspiration** of blood or cerebrospinal fluid.

After confirming placement, **20 mL of 0.25% levobupivacaine** is slowly injected. Proper spread of the drug in the caudal epidural space may be observed as separation of tissues on ultrasound.



Figure 2

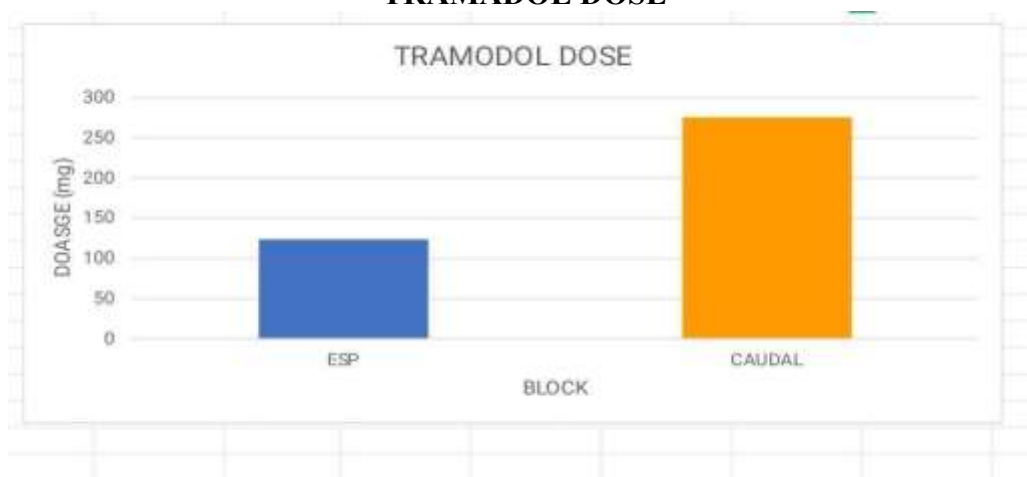
STATISTICAL ANALYSIS

Data were presented as mean, standard deviation, frequency and percentage.

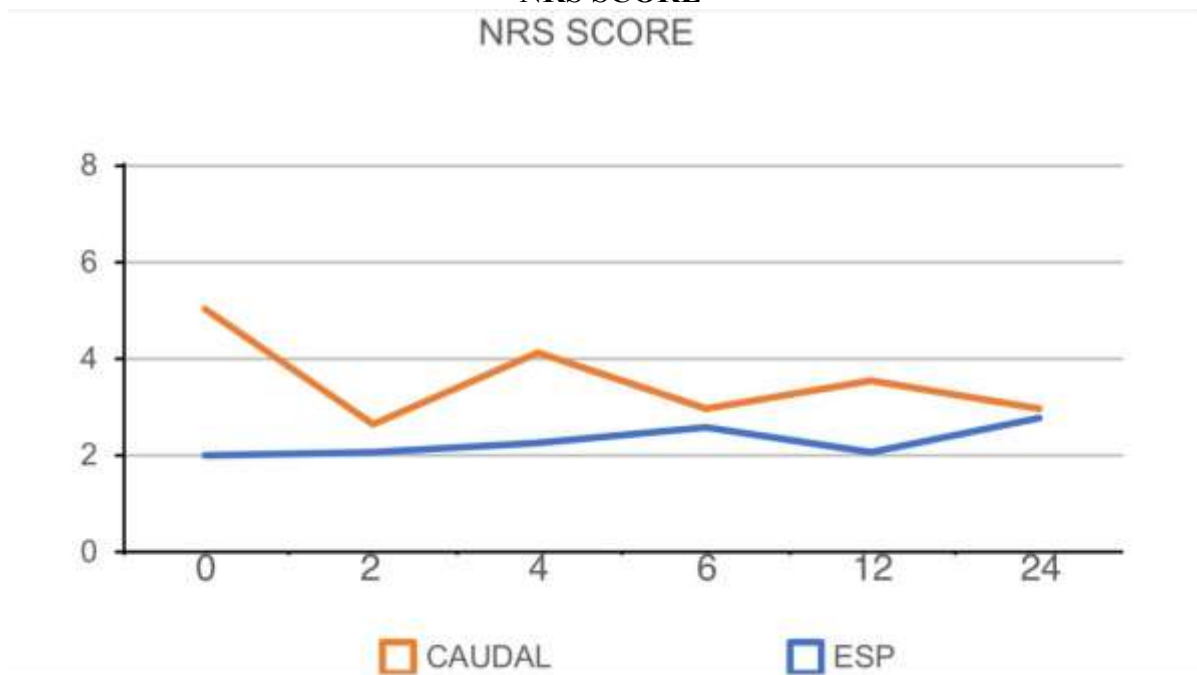
- Continuable variables were compared using the independent sample t-test.
- Categorical variables were compared using the Pearson chi-square test.
- Significance was defined by P values less than 0.05 using a two-tailed test.

RESULTS

TRAMADOL DOSE

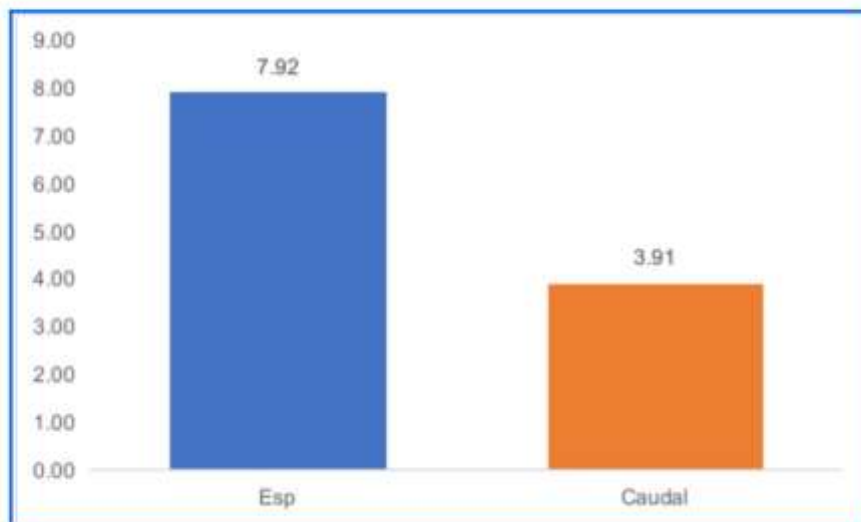


NRS SCORE



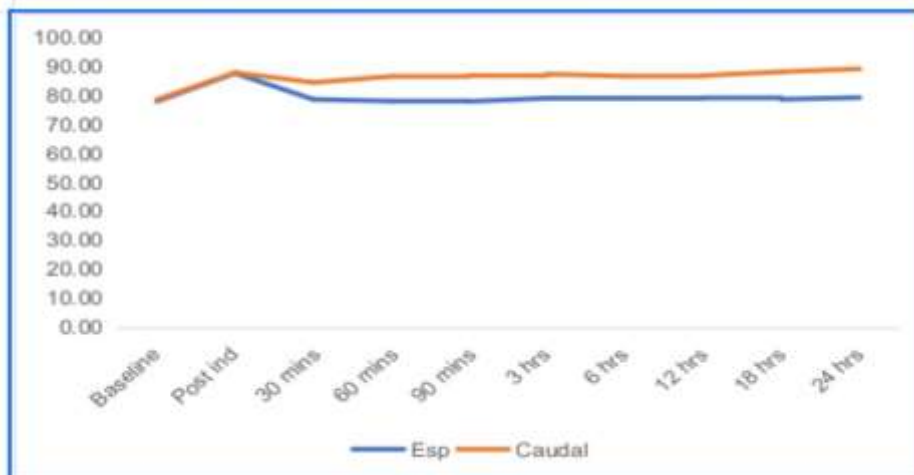
TIME FOR FIRST RESCUE ANALGESIA

	Group				P value
	Esp		Caudal		
	Mean	Standard Deviation	Mean	Standard Deviation	
1st rescue (hrs)	7.92	3.12	3.91	0.83	<0.0001

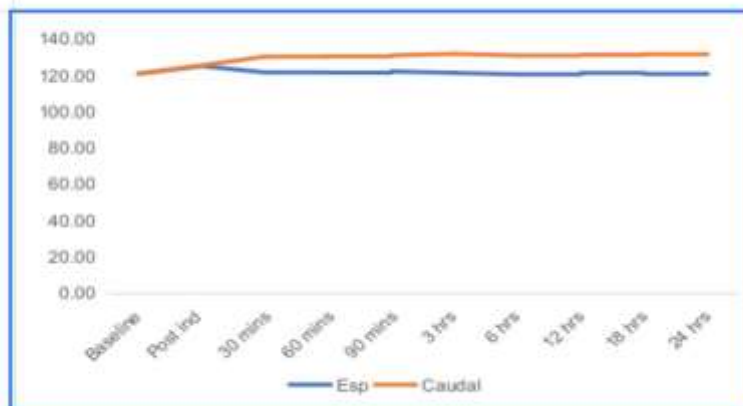


PERIOPERATIVE HEMODYNAMICS

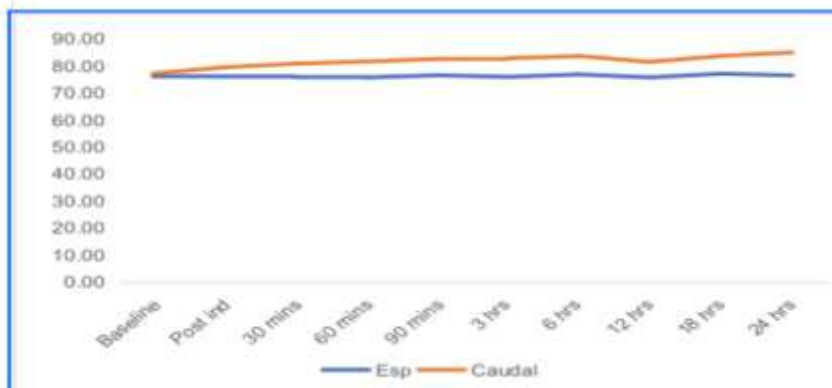
HEART RATE



SYSTOLIC BP



DIASTOLIC BP



DISCUSSION

- Pain control is essential for complex spine procedures involving multiple levels and extensive tissue dissection.
- Intravenous opioid analgesics are the most common approach to the treatment of moderate to severe postoperative pain. Their widespread use is, limited by their many side effects, importantly respiratory depression and gastrointestinal side effects.
- Erector spinae block gives effective longer duration of analgesia, compared to caudal epidural block
- The findings of this study are expected to contribute valuable insight into the ongoing comparison of regional anesthesia techniques for lumbar spine surgeries. The erector spinae plane (ESP) block, a relatively newer fascial plane block, is being increasingly adopted due to its safety profile, ease of administration, and effectiveness in providing both somatic and visceral analgesia. Our observational study intends to evaluate whether this technique can outperform or equate the well-established caudal epidural block, which, while effective, may be associated with more variability in drug spread and technical difficulty in adults.
- Preliminary literature suggests that ESP blocks provide effective multi-dermatomal analgesia by spreading local anesthetic in the fascial plane deep to the erector spinae muscle, affecting both dorsal and ventral rami of spinal nerves. In contrast, the caudal epidural block, traditionally used for lumbar and sacral analgesia, has shown variability due to anatomical differences and patient body habitus.
- The key considerations in comparing these techniques include block efficacy (pain scores), duration of analgesia (time to rescue analgesia), and total opioid requirement. If ESP block demonstrates comparable or superior outcomes, it could serve as a reliable alternative to caudal blocks, especially in adult populations where caudal blocks are technically more demanding.
- Moreover, intraoperative hemodynamic stability is another important parameter, particularly in patients undergoing spinal surgeries who may already be prone to blood loss and autonomic fluctuations. ESP blocks, by avoiding neuraxial spread and associated sympathectomy, may offer more stable hemodynamics.
- Limitations of this study include its observational design, which may introduce selection bias. Additionally, operator expertise, anatomical variability, and inter-patient differences in pain perception can influence outcomes.
- Future randomized controlled trials with larger sample sizes and longer follow-up are needed to validate these findings and expand the utility of ESP blocks in spine surgeries. Nevertheless, this study sets a foundation for considering ESP block as a promising, less invasive, and ultrasound-friendly alternative for peri-operative pain management in lumbar spine procedures.
- **Abdel et.al** conducted randomised control study comparing ultrasound guided caudal epidural block and lumbar ESPB for lumbar canal stenosis surgeries and concluded that lumbar ESPB provided better analgesia compared to caudal epidural which is in consistency with current study.
- **Yogin Patel et.al** conducted randomised control study compare the relative efficacy of ultrasound-guided ESPB and CEB for postoperative analgesia after a single-level lumbar fusion surgery and compared it with conventional multimodal analgesia. ESPB group had a longer duration of postoperative pain relief.

CONCLUSION

Bilateral US-ESP appears to be effective technique for delivering appropriate intraoperative & postoperative analgesia in lumbar spine surgeries. There is a significant reduction in opioid consumption in ESP group compared to US-CEB group

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