# Epidural Gelfoam Soaked with 0.5% Ropivacaine for Postoperative Pain Control in Single-Level Lumbar Spondylolisthesis Surgery: A Prospective Randomized Study

**Dr. Bhagwat Tewari[1*], Dr. Ramiz Memon[2], Dr. Vijay Anand B[3], Dr. Sabari Vaasan Lakshmi Kanthan[4]**

[1*]Postgraduate, Department of Orthopaedics, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India | Email: bt2131@srmist.edu.in

[2]Postgraduate, Department of Orthopaedics, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India | Email: Rm1416@srmist.edu.in

[3]Professor, Department of Orthopaedics, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India | Email: vijayanb@srmist.edu.in

[4]Associate Professor, Department of Orthopaedics, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India | Email: sabarivl@srmist.edu.in

**Corresponding author:** Dr. Bhagwat Tewari | Postgraduate, Department of Orthopaedics, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India | Email: bt2131@srmist.edu.in

***ABSTRACT***

**Background**

Pain following lumbar spine surgery remains a major concern and often delays recovery. Conventional analgesics, including opioids and NSAIDs, are effective but frequently associated with undesirable side effects. Local drug delivery systems may offer a safer and more sustained alternative.

**Aim**

To assess the effectiveness of epidural Gelfoam soaked in 0.5% ropivacaine in reducing postoperative pain following lumbar interbody fusion.

**Methods**

In this prospective randomized study, adult patients undergoing single-level lumbar stabilization were allocated into two groups. One group received Gelfoam soaked with 0.5% ropivacaine, while the control group received saline-soaked Gelfoam. Pain intensity was evaluated using the Visual Analog Scale (VAS) over the first 24 hours. Time to first rescue analgesia and total tramadol requirement over 48 hours were also recorded.

**Results**

Patients in the ropivacaine group experienced consistently lower pain scores and a significantly longer duration before requiring rescue analgesia ($p < 0.001$). Total tramadol consumption was markedly lower in this group, with the control group requiring approximately 2.4 times more analgesia. No significant adverse effects or hemodynamic instability were noted.

**Conclusion**

Epidural application of ropivacaine-soaked Gelfoam is a simple and effective technique for improving postoperative analgesia and reducing opioid requirements in lumbar spine surgery.

**Keywords:** Ropivacaine, Gelfoam, lumbar fusion, postoperative pain, VAS, analgesia.

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**Conflict of interest:** None.

## Introduction

Lumbar spine surgeries such as transforaminal lumbar interbody fusion (TLIF) are commonly performed for spondylolisthesis to relieve pain and restore stability. However, postoperative pain remains a significant concern, often delaying mobilization and increasing reliance on systemic analgesics.

Opioids and NSAIDs are widely used for pain control but are associated with adverse effects such as nausea, sedation, and respiratory depression (2). This has led to the adoption of multimodal analgesia techniques aimed at improving pain relief while reducing systemic complications.

Ropivacaine, a long-acting local anesthetic with a favorable safety profile, has been increasingly used for postoperative analgesia (4). Gelfoam, an absorbable gelatin sponge, can act as a drug delivery medium, allowing

gradual release of locally applied agents and prolonging their effect (6).

The present study was conducted to evaluate the analgesic efficacy of gelfoam soaked in 0.5% ropivacaine placed in the epidural space in patients undergoing single-level lumbar stabilization, with assessment of pain scores, time to rescue analgesia, and opioid consumption.

**Figure 1- shows Gel-foam, an absorbable gelatin sponge**

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## Materials and Methods

### Study Design and Setting

This prospective randomized study was conducted in the Department of Orthopaedics at a tertiary care center over a period of six months.

### Participants

Patients aged above 18 years undergoing single-level lumbar stabilization for spondylolisthesis were included after obtaining informed consent.

### Inclusion Criteria

- Age >18 years
- Single-level spondylolisthesis
- Preoperative VAS score >3

### Exclusion Criteria

- Known allergy to ropivacaine
- Significant cardiac, renal, or hepatic disease
- Pregnancy or lactation

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### Intervention

Participants were randomly assigned into two groups:

- **Ropivacaine group:** Gelfoam soaked in 0.5% ropivacaine placed epidurally
- **Control group:** Gelfoam soaked in normal saline

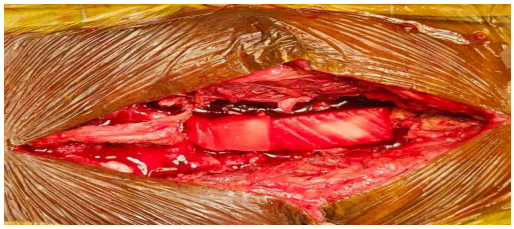

**Figure 2 - shows intra op image**


**Figure 3- shows Ropivacaine vial**

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### Outcome Measures

- Pain intensity using VAS at multiple intervals (0–24 hours)
- Time to first rescue analgesia
- Total tramadol consumption within 48 hours
- Postoperative hemodynamic parameters

**Statistical Analysis**

Data were analyzed using standard statistical methods, with a p-value <0.05 considered significant.

**Results**

**Patient Characteristics**

Both groups were comparable with respect to demographic variables and operative duration, with no statistically significant differences.

| Variable | Ropivacaine Group | Control Group | p-value |
|---|---|---|---|
| Age (years) | Comparable | Comparable | >0.05 |
| Gender (M/F) | Comparable | Comparable | >0.05 |
| Weight (kg) | Comparable | Comparable | >0.05 |
| Duration of surgery (min) | Comparable | Comparable | >0.05 |

**Interpretation:** No statistically significant differences between groups.

**Pain Scores**

Patients receiving ropivacaine demonstrated lower VAS scores at all time points within the

**Table 1- shows demographic comparison**

duration in this group.

| Time (hours) | Ropivacaine Group | Control Group | p-value |
|---|---|---|---|
| 0 | Lower | Higher | <0.05 |
| 1 | Lower | Higher | <0.05 |
| 2 | Lower | Higher | <0.05 |
| 4 | Lower | Higher | <0.05 |
| 8 | Lower | Higher | <0.05 |
| 12 | Lower | Higher | <0.05 |
| 18 | Lower | Higher | <0.05 |
| 24 | Lower | Higher | <0.05 |

**Table 2 – shows VAS score comparison**

**Interpretation:** Significantly better pain control in the ropivacaine

**Rescue Analgesia**

The time to first rescue analgesic requirement was significantly prolonged in the ropivacaine group ($p < 0.001$), indicating a longer duration of analgesic effect.

| Parameter | Ropivacaine Group | Control Group | p-value |
|---|---|---|---|
| Time to first analgesia (hrs) | Significantly longer | Shorter | <0.001 |

**Table 3 – shows rescue analgesia requirement**

**Analgesic Consumption**

Total tramadol requirement over 48 hours was substantially lower in the ropivacaine group. The control group required approximately 2.4 times more analgesia.

| Parameter | Ropivacaine. Group | Control Group | p-value |
|---|---|---|---|
| Total tramadol (mg) | Lower | 2.4× higher | <0.001 |

**Table 4 – shows Amount of analgesic comparison**

**Hemodynamic Stability and Safety**

No significant differences in heart rate, blood pressure, or oxygen saturation were observed. No adverse reactions related to ropivacaine were reported.

| Parameter | Ropivacaine Group | Contr |
|---|---|---|
| Heart Rate | Stable | Stable |
| Mean Arterial Pressure | Stable | Stable |
| Oxygen Saturation | Stable | Stable |

**Table 5 – shows Hemodynamic stability and safety comparison**

| Complication | Ropivacaine Group | Control Group |
|---|---|---|
| Nausea/Vomiting | None/Minimal | Minimal |
| Respiratory depression | None | None |
| Sedation | None | None |

**Table 6 – shows complication comparison**

## Discussion

This study evaluated the role of gelfoam soaked with 0.5% ropivacaine in providing postoperative analgesia following lumbar spine surgery. The results indicate that epidural placement of ropivacaine via gelfoam offers better pain control compared to the control group.

Postoperative pain after lumbar procedures is often significant and commonly managed with systemic analgesics, which are associated with multiple side effects (2). In this context, local drug delivery methods have gained importance as part of multimodal analgesia.

In the present study, patients receiving ropivacaine demonstrated lower VAS scores throughout the first 24 hours, suggesting effective and sustained pain relief. The use of gelfoam likely allows gradual release of the drug in the epidural space, thereby prolonging its analgesic effect (3,6).

A significant finding was the prolonged time to first rescue analgesia in the ropivacaine group ($p < 0.001$), indicating better early postoperative comfort. In addition, total tramadol consumption was markedly reduced, with the control group requiring approximately 2.4 times more analgesia. This reduction is clinically relevant as it helps minimize opioid-related adverse effects (1,3).

Hemodynamic parameters remained comparable between both groups, indicating that this technique is safe and does not produce systemic instability.

These findings are in line with previous studies that have shown improved postoperative analgesia with epidural local anesthetics and gelfoam-based delivery systems (1,3,6).

Overall, the study suggests that gelfoam soaked in ropivacaine is a simple and effective method to enhance postoperative analgesia and reduce opioid requirement in lumbar spine surgery.

## Limitations

- **Small sample size** → limits generalizability of findings
- **Short follow-up period (24–48 hrs)** → long-term analgesic effects not assessed
- **Single-center study** → results may not reflect broader population
- **Lack of blinding** → potential observer and patient bias
- **Subjective pain assessment (VAS score)** → influenced by patient perception
- **No comparison with other local anesthetic agents**
- **No dose variation studied** → fixed concentration of ropivacaine used
- **No cost-effectiveness analysis performed**
- **No assessment of long-term complications or neurological outcomes**
- **Variability in individual pain tolerance and opioid requirement**

## Conclusion

Gelfoam soaked in 0.5% ropivacaine provides effective postoperative analgesia in patients undergoing lumbar spine surgery. It is associated with lower pain scores, delayed need for rescue analgesia, and reduced opioid consumption.

The technique was found to be safe, with no significant hemodynamic changes or adverse effects. Its ease of application and sustained analgesic effect make it a useful addition to multimodal pain management strategies.

Further studies with larger sample sizes are required to confirm these findings and establish its wider clinical use.

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