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# Timing of Lumbar ESIs: Do Pre-operative Epidural Injections Effect Lumbar Spine Surgery Outcomes

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## Abstract

The management of lumbar spine disorders often require a multimodal approach, with surgery considered for those unresponsive to conservative treatments. Lumbar Epidural Steroid Injections (ESIs) are widely adopted for symptom alleviation and functional enhancement. While preoperative lumbar ESIs are proposed to enhance surgical outcomes, recent studies express concerns about complications, particularly an elevated risk of Postoperative Infections (POIs) due to corticosteroids.

The intricate link between preoperative lumbar ESIs and surgical outcomes has been extensively explored. Retrospective analyses indicate a noticeable reduction in preoperative pain scores post-ESIs, suggesting potential synergy with surgical outcomes. The anti-inflammatory and analgesic properties of ESIs may positively impact the perioperative period, though apprehensions persist about associated risks, including infection and delayed wound healing. Temporal considerations are crucial, with studies indicating an augmented risk of POIs when ESIs are administered within a month before lumbar spine surgeries. Moreover, elevated intraoperative Dural Tear (DT) has been observed within three months of post-ESI, attributed to steroid effects on local tissue, particularly collagen and fibroblasts. DT risk is higher in elderly patients with reduced capacity for efficient return to normal fibroblast function. Pragmatic clinical decision-making emphasizes strategic surgery delay after ESI to mitigate risks. Individualized considerations guided by shared decision-making become imperative for optimizing outcomes.

Further research is warranted, particularly through Randomized Controlled Trials (RCTs), to elucidate and refine the intricate relationship between preoperative lumbar ESIs and subsequent surgical outcomes. RCTs should encompass diverse outcome measures, beyond preoperative pain scores, including function improvement and complications. The implementation of standardized protocols in RCTs will contribute to evidence-based guidelines and serve as foundational pillars in optimizing patient care in lumbar spine surgery. In our review, we aim to explore the temporal aspects of lumbar ESIs and their impact on outcomes in lumbar spine surgery.

**Keywords:** Lumbar spine surgery; Epidural steroid injection; Quality outcomes

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## Introduction

The management of lumbar spine disorders often involves a multimodal approach, with surgical measures considered a viable option for patients exhibiting inadequate responses to conservative treatments [1]. Lumbar Epidural Steroid Injections (ESIs) have emerged as a widely adopted therapeutic modality, demonstrating efficacy in alleviating symptoms and enhancing functional status among patients with lumbar spine pathologies [2,3]. These can be performed by a transforaminal, interlaminar,

or caudal approach by injection of either a steroid alone or in combination with a local anaesthetic agent [4].

Notably, the therapeutic potential of preoperative lumbar ESIs in mitigating preoperative pain and inflammation prompted a deeper exploration into their effects on subsequent surgical interventions [5]. However, recent studies have proposed apprehensions regarding potential complications, with a notable focus on the elevated risk of Postoperative Infections (POIs) [5]. This concern is attributed to the immunosuppressive effects of corticosteroids, potentiated by the prolonged half-life of epidurally administered steroids [6,7]. Moreover, corticosteroids exert a notable impact on local biochemistry, potentially inducing alterations in tissue biology, including the development of hyper vascularity and epidural scarring [8]. These changes may give rise to a spectrum of challenges that are atypical in conventional clinical scenarios.

Our review aims to explore the temporal aspects of lumbar ESIs, analyzing the intricate interplay between their administration, the surgical timeline, and the resulting outcomes [9,10]. We aim to provide a comprehensive guide for clinicians and researchers helping navigate the intricacies inherent in lumbar spine surgery.

## Literature Review

The intricate interplay between preoperative lumbar ESIs and surgical outcomes presents a multifaceted landscape in the realm of spine surgery [11]. Numerous empirical studies have examined the influence of preoperative ESIs on crucial dimensions such as pain relief, functional improvement, and the occurrence of postoperative complications [12,13].

Recent retrospective analyses have revealed a significant reduction in preoperative pain scores among patients undergoing lumbar spine surgeries with preoperative ESIs [14,15]. This observation prompted the hypothesis that adequate preoperative pain management may substantially contribute to optimizing surgical outcomes [16].

A paramount consideration lies in comprehending the potential mechanisms underlying the impact of preoperative lumbar ESIs on surgical outcomes. The intrinsic anti-inflammatory and analgesic properties inherent in steroids administered through ESIs hold promise for significantly reducing preoperative pain, thereby exerting a positive influence on the perioperative period [17]. Nevertheless, persistent concerns linger regarding potential risks associated with corticosteroid use, spanning infection, Dural Tear (DT), delayed wound healing, and other complications [18].

Temporal considerations play a crucial role in postoperative outcomes and complications in various lumbar spine surgeries procedures, including decompression [7, 19-21], fusion [20,22-24], or a combination of both [25,26] **(Table 1)**. Studies consistently highlight that preoperative ESIs administered within one month preceding lumbar spine decompression or fusion correlate with an augmented risk of POIs. This temporal phenomenon aligns coherently with the well-established immunosuppressive effects of steroids [27].

**Table 1:** Characteristics of studies stratified by lumbar spine surgery procedure.

| Author (year) | Study dates | Surgical procedure | Study design | Infection | ESI |
|---|---|---|---|---|---|
| Lumbar Spine Decompression | | | | | |
| Yang et al.(2016) [7] | 2005-2012 | Primary single-level lumbar decompression | Proprietary Medicare claims database (PearlDriver) (CPT, ICD-9) | 90 days POI (ICD-9, CPT) | Transforaminal or interlaminar ESI** |
| Seavey et al. (2017) [21] | 2009-2014 | Single-level lumbar decompression without instrumentation | Military health system data repository searched (CPT, ICD-9) | 90 days POI (ICD-9) | Transforaminal or interlaminar ESI. 64% (539/847) received single ESI, 22% received 2, 9% received 3, and 4% received >3 ESI |
| Donnally et al. (2018) [19] | 2005-2014 | Primary single-level lumbar decompression without instrumentation | Proprietary Medicare claims database (PearlDriver) (CPT, ICD-9) | 90 days POI (ICD-9, CPT) | Transforaminal or interlaminar ESI** |
| Kreitz et al. (2020) [20] | 2000-2017 | Lumbar decompression* | Single academic orthopedic practice (CPT, ICD-9) | 90 days POI (ICD-9) | Transforaminal or interlaminar ESI** |
| Lumbar Spine Fusion | | | | | |
| Singla et al. (2017) [24] | 2005-2012 | Single or multilevel posterior lumbar spinal fusion | Proprietary Medicare claims database (PearlDriver) (CPT, ICD-9) | 90 days POI (ICD-9, CPT) | Transforaminal or interlaminar ESI** |
| Pisano et al. (2020) [23] | 2009-2014 | Single or multilevel lumbar spine fusion | Military health system data repository (CPT, ICD-9) | 90 days POI (ICD-9) | Transforaminal and interlaminar ESI (348/612=0.57) Facet joint injections (264/612=0.43) |
| Kreitz et al. (2020) [20] | 2000-2017 | Lumbar fusion* | Single academic orthopedic practice (CPT, ICD-9) | 90 days POI (ICD-9) | Transforaminal or interlaminar ESI** |

| | | | | | |
|---|---|---|---|---|---|
| Li et al. (2020) [22] | 2015-2019 | Instrumented posterior lumbar fusion* | Prospective study, single institution | 6 months POI (prospectively) | Transforaminal ESI** |
| Lumbar Spine Decompression and Fusion Combined | | | | | |
| Hartveldt et al. (2016) [25] | 2005-2015 | Single or multilevel decompression and fusion | Retrospective study at 2 affiliated tertiary care referral centers (CPT, ICD-9) | 90 days POI requiring incision and drainage in OR | Transforaminal or interlaminar ESI** |
| Koltsov et al. (2021) [26] | 2007-2015 | Decompression, fusion, interbody fusion, discectomy | Proprietary nationally representative database (MarketScan) (CPT, ICD-9) | 90 days POI (ICD-9, CPT) | Transforaminal or interlaminar ESI** |

**Note:** POI: Postoperative Infection; ESI: Epidural Steroid Injection; OR: Operating Room; ICD: International Classification of Diseases; CPT: Current Procedural Terminology, *number of levels not specified ** number of subjects with multiple injections not reported.

Moreover, a study by Shakya et al. revealed a noteworthy finding that a preoperative lumbar ESI given within three months of surgery significantly elevates the risk of an intraoperative DT ($p<0.05$). Interestingly, occurrences of POIs and other complications remained comparable regardless of the history of ESIs [28].

In clinical scenarios where shared decision-making facilitates optimal risk mitigation, adopting a strategy of delaying surgery for one month post-ESI in younger adults and up to three months in older adults emerges as a judicious and reasonable management approach.

## Discussion

The multifaceted exploration of the intricate relationship between preoperative lumbar ESIs and surgical outcomes unveils a nuanced landscape in the realm of spine neurosurgery [20]. Recent retrospective analyses have elucidated a discernible reduction in preoperative pain scores among patients undergoing ESIs, suggesting a potential synergy between pain management and favourable surgical outcomes [5]. A comprehensive understanding of the underlying mechanisms is imperative, considering the anti-inflammatory and analgesic properties of steroids administered through ESIs, while concurrently acknowledging persistent concerns related to associated risks [27,29].

Temporal considerations introduce an additional layer to this relationship, with studies highlighting an increased risk of POIs when preoperative ESIs are administered within a month of lumbar spine surgeries [30]. Furthermore, an elevated incidence of intraoperative DT has been observed when surgery was performed within three months post-ESI [28]. This phenomenon can be attributed to the direct effects of steroids on the local tissue. Collagen, the most common structure in the extracellular matrix of the meninges, undergoes alterations due to the inhibitory effects of corticosteroids on fibroblasts, affecting their intracytoplasmic mitochondria [31,32]. Dura injected with corticosteroids exhibits a significantly decreased number of intracytoplasmic mitochondria in dural fibroblasts, leading to compromised function. This results in decreased collagen production, eventually compromising the material properties of the dural tissue and making it susceptible to tear even with minor injury [31]. The heightened occurrence of DT observed in patients administered steroids within three months of surgery can be attributed to the peak steroid effects during this period [33]. The effects gradually diminish over time as fibroblasts regain normal functionality. Additionally, the risk of DT is more pronounced in elderly patients, who may exhibit a reduced capacity for efficient return to normal fibroblast function [34].

This temporal dimension advocates for a pragmatic approach in clinical decision-making, emphasizing the potential benefit of strategically delaying surgery after an ESI to mitigate risks. The necessity for individualized considerations across diverse patient populations, guided by shared decision-making, becomes imperative in optimizing outcomes.

Looking ahead, the imperative for additional Randomized Controlled Trials (RCTs) becomes evident, aiming to elucidate and refine our comprehension of the intricate relationship between preoperative lumbar ESIs and subsequent surgical outcomes [35,36]. These trials should extend beyond the singular focus on validation of the observed reduction in preoperative pain scores, evolving into systematic investigations encompassing a diverse range of outcome measures, including functional improvement and complications. The implementation of standardized protocols within these trials will not only contribute to the formulation of evidence-based guidelines but will also serve as foundational pillars in optimizing patient care with tailored approach for each intervention within the dynamic landscape of lumbar spine surgery [37].

## Conclusion

Our review underscores the intricate relationship between preoperative lumbar ESIs and surgical outcomes within the realm of lumbar spine surgery. While acknowledging the potential advantages of sufficient preoperative pain management and functional enhancement, we emphasize the necessity for a thorough evaluation of associated risks.

As empirical evidence unveiled a notable reduction in preoperative pain scores following lumbar ESIs, our understanding of this intervention was propelled beyond mere palliation, signalling their potential to optimize surgical results. However, these advancements are tempered by lingering concerns with increased risk of POIs. The temporal dimension of this relationship

introduces a pragmatic layer to clinical decision-making across diverse patient populations.

This review advocates for a comprehensive and individualized approach to optimized patient care, highlighting the critical need for a nuanced strategy, further research endeavours through RCTs, and a steadfast dedication to advancing the evidence base in lumbar spine surgery.

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