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LUMBAR EPIDURAL STEROID INJECTION APPROACHES FOR LOW BACK AND RADICULAR PAIN: A COMPARATIVE REVIEW OF TRANSFORAMINAL, INTERLAMINAR, AND CAUDAL TECHNIQUES

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Background: Lumbar epidural steroid injections (LESIs) are widely used to manage radicular low back pain. However, clinicians must select from three distinct anatomical approaches: transforaminal (TFESI), interlaminar (ILESI), and caudal (CLESI), each possessing unique technical, efficacy, and safety profiles.

Objective: To systematically synthesize and compare the anatomical targets, therapeutic efficacy, indications, and safety risks associated with TFESI, ILESI, and CLESI.

Methods: A comprehensive search of peer-reviewed literature was conducted using PubMed and EMBASE for clinical trials, meta-analyses, and society guidelines evaluating LESI approaches. Primary outcomes included short- and long-term pain relief, functional recovery, and procedure-related adverse events.

Results: TFESI provides the highest target specificity, delivering medication directly to the anterior epidural space at the affected nerve root. It yields superior short-term pain reduction with lower injectate volumes, but carries a higher risk of severe neurological complications from particulate embolization. ILESI distributes medication diffusely across the posterior epidural space, offering effective bilateral relief for multi-level degenerative disease or central stenosis, with negligible vascular risk but a higher incidence of accidental dural puncture. CLESI provides safe access via the sacral hiatus with minimal dural puncture risk; despite requiring larger volumes to reach upper lumbar segments, it remains the optimal choice for post-laminectomy syndrome or complex spinal anatomy. Long-term results of these three different epidural approaches are not statistically different. For some clinical situations, it is reasonable to use a combination of TFESI and CLESI or TFESI and ILESI.

Conclusion: Selection of an LESI route should be individualized based on pathology, target anatomical compartment, and patient surgical history. TFESI excels for focal unilateral

radiculopathy, ILESI for multi-level or central pathology, and CLESI for post-surgical or altered anatomy.

Keywords: Low back pain; Radiculopathy; Lumbar epidural steroid injection; Transforaminal; Interlaminar; Caudal; Interventional pain management.