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Review

# Failed labour epidural analgesia: mechanisms, risk factors and stepwise management: Guideline-based review

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## ABSTRACT

**Bacgkround:** Epidural analgesia is the most widely used neuraxial technique for labour pain management; however, inadequate or failed analgesia remains a frequent and clinically relevant problem. This review aims to summarise the mechanisms and risk factors associated with failed labour epidural analgesia and to present a stepwise management approach aligned with current European Society of Anaesthesiology and Intensive Care (ESAIC) guidance.

**Methods:** A review of clinical guidelines, observational studies and interventional trials addressing labour epidural failure, breakthrough pain and rescue strategies was performed.

**Results:** Failed labour epidural analgesia is a multifactorial condition involving catheter-related issues such as suboptimal insertion depth, migration, unilateral or patchy block and unintended catheter placement, in addition to maternal, obstetric and operator-related factors. Effective management requires structured reassessment of pain characteristics, labour progression, sensory block level, catheter position and infusion parameters. Stepwise rescue strategies, including catheter manipulation, patient repositioning and adjustment of local anaesthetic dosing, may restore analgesic efficacy. Persistent inadequacy necessitates timely senior review and early consideration of catheter re-siting or alternative neuraxial techniques.

**Conclusions:** Early recognition and structured, stepwise management are essential for the effective treatment of failed labour epidural analgesia. Adherence to evidence-based guidelines, optimization of technical practice and appropriate organisational support may reduce failure rates and improve maternal outcomes.

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## 1. Introduction

Epidural analgesia has been the predominant and most effective neuraxial technique for labour pain management since its widespread adoption in the 1960s and is currently regarded as the gold standard in obstetric anaesthesia [1]. Ideal pain management during childbirth should be integrated with a multidisciplinary care approach that is centred on the mother's requests and rights, and is specifically tailored to both patients (mother and foetus), alongside the competent application of advanced neuroaxial techniques [2]. International organisations, including the World Health Organization, support its use in appropriate clinical settings due to its superior analgesic efficacy and favourable maternal and fetal outcomes [1]. In addition to epidural analgesia, the use of advanced techniques such as combined spinal-epidural (CSE) and dural puncture epidural (DPE) has

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increased analgesic efficacy, enabling more personalised approaches to pain management [3,4]. Despite these advantages, inadequate or failed labour epidural analgesia remains a frequent and clinically relevant problem in daily practice.

Reported failure rates vary widely across the literature, largely due to differences in definitions and outcome measures. Large retrospective analyses have demonstrated that a significant proportion of parturients experience incomplete analgesia, recurrent breakthrough pain or require epidural catheter replacement during labour [5]. Importantly, epidural failure is not confined to the absence of analgesia following initial catheter placement but also includes secondary loss of effect as labour progresses. Breakthrough pain is a key clinical indicator of functional epidural failure and is consistently associated with increased rates of catheter re-siting [6,7].

The mechanisms underlying failed labour epidural analgesia are multifactorial. Catheter migration, suboptimal insertion depth, unilateral or patchy block, sacral sparing and unintended intravascular or subdural placement all contribute to inadequate neuraxial spread [5,8]. In addition, the dynamic physiological changes of labour, evolving pain characteristics and obstetric factors may compromise analgesic effectiveness over time, even when initial catheter placement appears technically satisfactory.

Given this complexity, the European Society of Anaesthesiology and Intensive Care (ESAIC) emphasises the importance of early recognition of inadequate epidural analgesia and the use of structured, stepwise management pathways [9]. The ESAIC focused guidelines advocate systematic reassessment, timely rescue strategies and prompt escalation to catheter re-siting or alternative neuraxial techniques when indicated. Beyond technical considerations, organisational factors such as staffing, supervision, training and interdisciplinary communication play a critical role in ensuring consistent and effective epidural services [9,10].This review aims to synthesise current evidence on the mechanisms and risk factors associated with failed labour epidural analgesia and to present a structured, stepwise management approach aligned with contemporary ESAIC guidance.

## 2. Materials and Methods

This study was conducted as a guideline-based structured review based on the *ESAIC focused guidelines for the management of the failing epidural during labour epidural analgesia*. The review aimed to synthesise existing guideline recommendations together with recent evidence and to provide a practical, stepwise approach for clinical practice. A literature search was performed in PubMed/MEDLINE and the Cochrane Library to identify studies relevant to the clinical scope addressed in the ESAIC guideline. The search included studies published between January 2017 and February 2025. This time frame was selected to capture contemporary evidence reflecting current clinical practice, as earlier literature had already been comprehensively evaluated during guideline development. Search terms (MeSH and free text) included combinations of: "labour epidural analgesia", "failed epidural", "epidural failure", "inadequate epidural", "breakthrough pain", "epidural troubleshooting", "epidural catheter replacement", "combined spinal epidural", and "dural puncture epidural". Eligible studies included randomized controlled trials, observational studies, systematic reviews, and relevant clinical guidelines published in English and available in full text. Studies not related to obstetric epidural analgesia, case reports without clinically relevant outcome data, and studies with insufficient methodological detail were excluded. Titles and abstracts were screened for relevance, followed by full-text review. Due to clinical and methodological heterogeneity among studies, quantitative meta-analysis was not performed and the evidence was synthesised qualitatively. The findings were integrated with ESAIC guideline recommendations and organised into a clinically oriented stepwise management algorithm (Fig. 1).

## 3. Definitions and Mechanisms of Failure

Failed epidural analgesia is commonly defined by the inability to achieve adequate pain relief within the first 45 minutes following initiation, the occurrence of dural puncture, the need for catheter repositioning or discontinuation, or maternal dissatisfaction with analgesia [11]. Within this framework, an incomplete epidural block encompasses inadequate sensory blockade (below the T10 dermatome), unilateral or patchy block patterns, or insufficient analgesic intensity despite an apparently adequate sensory level. In contrast, breakthrough pain refers to the recurrence of pain during labour in parturients with previously effective epidural analgesia [9].

Failed epidural analgesia may result from several interacting mechanisms, including:

- Catheter migration or suboptimal insertion depth leading to unilateral or diminishing block [12,13];
- Incomplete neural blockade with patchy and lateralized block patterns [9];
- Intravascular or subdural placement, occasionally presenting with breakthrough pain or systemic symptom [9,11]; and
- Dynamic labour physiology, which may alter drug spread over time [7,9].

Continuous reassessment is therefore essential, as an initially effective block may subsequently deteriorate despite apparently correct placement.

## 4. Risk Factors

Failed or inadequate epidural analgesia results from the interaction of maternal, obstetric, operator-related and technical factors. Maternal contributors include high BMI, poorly defined anatomical landmarks, nulliparity, increased fetal weight, advanced cervical dilation at the time of insertion, rapidly progressing labour and severe pre-procedural pain. These conditions may hinder optimal drug spread within the epidural space and increase the likelihood of breakthrough pain and secondary loss of efficacy [5,7,12,14–16]. Obstetric

characteristics such as fetal malposition (e.g., occiput posterior), a prolonged second stage and dysfunctional labour patterns have likewise been associated with unilateral block or progressive loss of analgesic effect [10]. The main risk factors associated with epidural failure are summarised in Table 1.

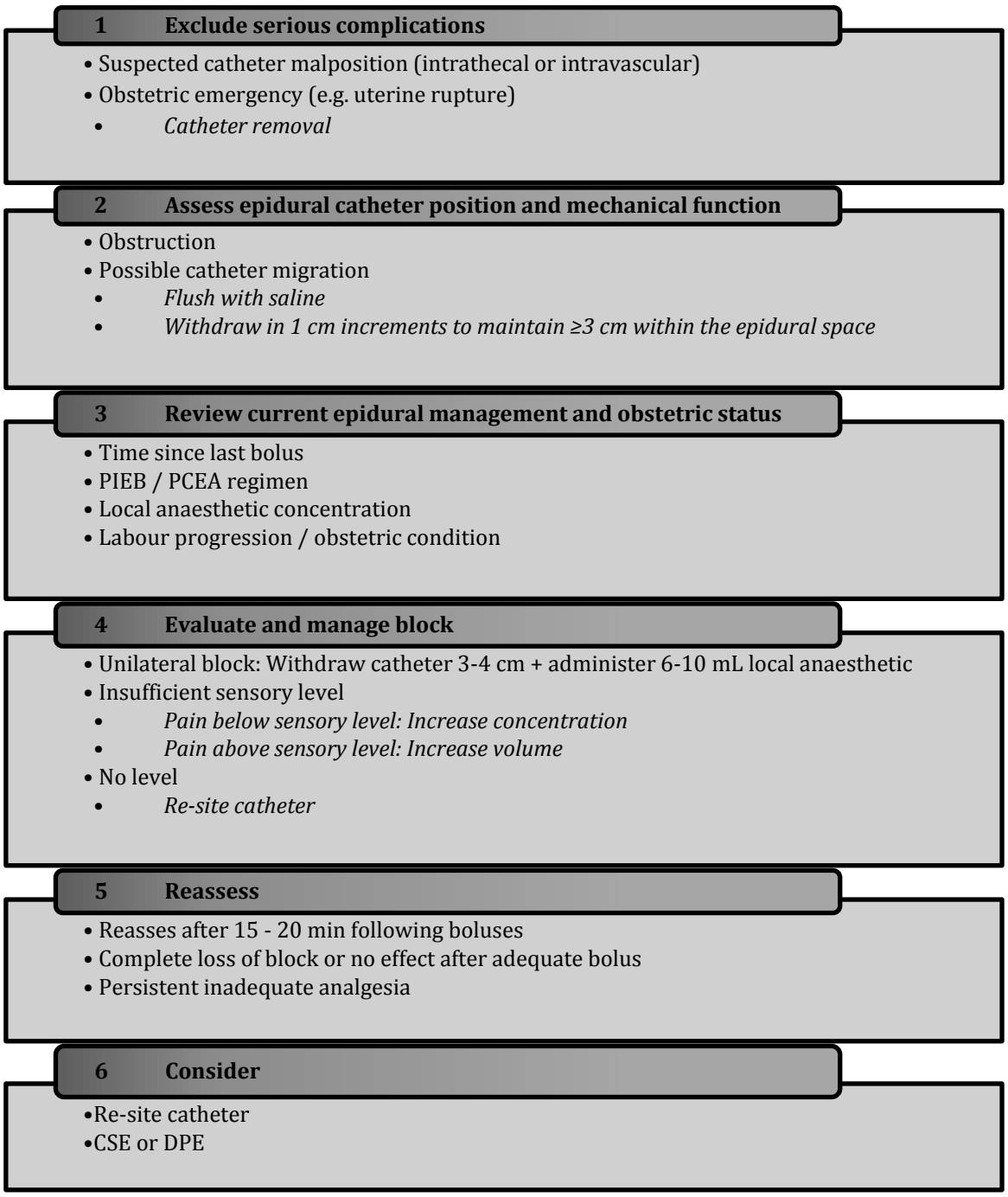


**Fig. 1.** Stepwise management of failed labour epidural analgesia.

**Table 1.** Risk factors for epidural failed in labour.

| Maternal risk factors | Obstetric risk factors |
|---|---|
| High Body Mass Index | Nulliparity |
| Structural back abnormalities | Increased foetal weight |
| Opioid tolerance | Abnormal foetal presentation |
| Increasing age | Induction/augmentation of labour |
| Previous history of failed epidural | Epidural request at cervical dilatation >7 cm |
| Poor patient cooperation | Prolonged/rapid labour progression |

Operator experience represents a major determinant of success. In a cohort of 1,521 labour epidurals, Thangamuthu et al. demonstrated significantly higher rates of failure and catheter re-siting among junior trainees compared with senior anaesthetists, despite similar procedural conditions [11]. Similarly, another study reported that unsuccessful epidural analgesia was associated with a high foetal head level, oxytocin use, and low seniority of the anaesthetist; moreover, unsuccessful epidural analgesia was linked to lower patient satisfaction and increased complication rates, including dural puncture and post-dural puncture headache [17]. These findings are consistent with guideline recommendations emphasising structured supervision, timely escalation of care, and repeated reassessment during labour.

Technical and catheter-related factors have a central role. Optimal catheter insertion depth appears to fall between 5–6 cm; both shallow (<3 cm) and deep (>7 cm) insertions have been associated with increased failure, patchy block and secondary loss of effect [8]. Catheter migration and inadequate fixation remain among the most consistent and modifiable contributors to unilateral or diminishing block, as also demonstrated in fixation trials such as Odor et al., where outward displacement predicted the need for re-placement [8]. Catheter stiffness, multi-orifice catheter design, the choice of loss-of-resistance medium (air vs saline) and insufficient initial dosing have likewise been implicated in incomplete neuraxial spread.

Non-technical and communication-related factors also play a measurable role. Poor patient cooperation, inadequate counselling and suboptimal communication among team members may delay recognition of evolving failure or breakthrough pain, a point emphasised in both ESAIC guidance and contemporary reviews such as Guasch et al., which highlight the multifactorial nature of epidural failure and the importance of early recognition and structured team response [9,10].

## 5. Assessment and Management

Assessment and management of inadequate labour epidural analgesia should follow a continuous, structured pathway consistent with the ESAIC PICO framework. The first step involves systematic reassessment (PICO 1). The nature, severity and location of pain should be clarified, labour progression reviewed and obstetric causes such as uterine rupture, dystocia or placental abruption excluded [9]. Sensory block levels must be reassessed, confirming adequate catheter depth (≥3 cm) within the epidural space, verifying the absence of migration and ensuring correct drug concentration, infusion rate and pump function prior to administering any rescue bolus [9].

Once inadequate analgesia is confirmed, stepwise troubleshooting should be initiated. When a rescue bolus provides no meaningful improvement—or when a potentially hazardous cause such as intrathecal or intravascular catheter placement is suspected—the epidural should be promptly removed and replaced. If partial relief is achieved, additional manual boluses of 6–10 ml of an appropriate local anaesthetic may be used, allowing 20–30 minutes between doses to reassess block development. Higher concentrations than those used for maintenance can be considered when the sensory block appears adequate but pain control remains incomplete. At each stage, analgesic effectiveness must be re-evaluated; persistent pain after a second top-up should trigger consideration of catheter replacement. Unilateral or markedly asymmetrical block warrants targeted catheter manipulation. Withdrawing the catheter until approximately 3–4 cm remain in the epidural space, followed by a 6–10 ml bolus, may enhance drug spread. Positioning the patient laterally on the side of inadequate block during the bolus can further facilitate distribution. As with other troubleshooting measures, reassessment after 20–30 minutes is essential; continued asymmetry or insufficient analgesia despite these interventions strongly supports the need for re-siting [9]. The stepwise management approach is illustrated in Fig. 1.

PICO 2 addresses the most suitable neuroaxial technique to be applied when the decision is made to reposition the epidural catheter. In this context, the Combined Spinal-Epidural technique is recommended for its faster onset of action and more reliable block, while the Dural Puncture Epidural technique is considered an alternative option, particularly for high-risk pregnancies [9]. In this context, the combined spinal-epidural (CSE) technique offers several advantages, including a faster onset of analgesia, reduced local anaesthetic requirements and a lower need for repeated rescue dosing. This reduces the risk of inadequate epidural analgesia and improves maternal satisfaction [18,19]. Within this broader framework, dural puncture epidural (DPE) analgesia may offer faster and satisfactory pain control without an increase in maternal or fetal adverse events compared with conventional epidural analgesia [20]. Combining it with programmed intermittent epidural bolus (PIEB), it may further facilitate a more rapid onset of analgesia and improve sacral block and overall analgesic quality [21].

The use of combined spinal–epidural and patient-controlled analgesia techniques, alignment between antenatal preferences and intrapartum practice, and active involvement of women in informed decision-making improves maternal satisfaction with neuraxial analgesia during labour [22].

Within PICO 3, the evaluation of labour epidural analgesia should not rely solely on reactive responses to reported pain but should incorporate a proactive strategy supported by structured, objective bedside assessments**.** The effectiveness of epidural analgesia should be monitored using parameters such as the Visual Analogue Pain Scale (VAPS)**,** motor block assessment with the Bromage score**,** and sensory block level, assessed in a systematic manner.The guideline highlights that, particularly in high-risk parturients**,** periodic documentation at 1–2-hour intervals may facilitate earlier recognition of epidural deterioration and shorten the time to appropriate intervention. Rising pain scores, inadequate sensory blockade, or discordance between motor block and analgesic effect should be interpreted as early clinical indicators of a potentially failing epidural.When interpreted together, these objective measures allow clinicians to distinguish true epidural failure from insufficient dosing, asymmetric block distribution, or pain escalation related

to rapidly progressing labour, thereby supporting timely and proactive clinical decision-making [9]. Taken together, these steps provide a structured and guideline-aligned framework for the recognition and management of failed epidural analgesia during labour.

## 6. Organisational and System-Level Factors

Beyond technical and patient-related causes, system-level factors play an increasingly recognized role in the success of labour epidural analgesia. Structured training models, staffing frameworks and decision-support pathways may substantially influence the reliability of epidural services and the timely management of failure. Emerging evidence suggests that competency-based educational approaches, such as Proficiency-Based Progression training, have the potential to improve both technical performance and clinical decision-making. This review therefore examines failed labour epidural analgesia through a system-oriented lens, integrating organisational, educational and clinical perspectives [23].

Within this framework, several organisational factors have been identified as key determinants of clinical outcomes. Adequate staffing models and timely availability of senior anaesthetists are essential to support rapid reassessment and prevent prolonged ineffective troubleshooting, reflecting the intent of the PICO 4 framework. PICO 5 highlights the importance of structured training and skill maintenance: units with defined competency pathways, supervised procedures and simulation-based troubleshooting demonstrate higher block success rates and more consistent decision-making regarding when to escalate or re-site a catheter. Finally, PICO 6 addresses the management of epidural failure in women requiring intrapartum conversion to caesarean delivery. In these situations, clear decision algorithms are needed to determine whether the existing epidural can be safely extended, whether re-siting or switching to a combined spinal-epidural technique is preferable or whether rapid induction of general anaesthesia is warranted. Together, these organisational factors shape the reliability of epidural services and directly affect maternal outcomes, illustrating that the management of failed labour epidural analgesia extends beyond catheter manipulation to encompass system-wide preparedness [9].

## 7. Prevention

Preventive strategies are essential to minimise secondary failure and reduce the need for catheter re-siting. Evidence consistently supports maintaining an optimal catheter depth of 5–6 cm within the epidural space, as both excessively superficial (<3 cm) and excessively deep placements (>7 cm) are associated with unilateral block, patchy spread and higher failure rates [8]. Secure fixation is equally important to prevent outward migration during labour positioning or maternal movement. The use of structured communication pathways between anaesthesia, obstetrics and midwifery teams has been shown to reduce delays in reporting breakthrough pain and facilitate timely escalation [9].

Modern delivery systems such as PCEA and PIEB may improve block consistency by offering more stable drug distribution and reducing breakthrough episodes, although their superiority remains context dependent. Standardised training programmes, supervision of trainees and institutional protocols for troubleshooting also contribute to preventing failure by ensuring consistent technical performance. Taken together, these preventive measures aim to reduce the incidence of inadequate epidural analgesia and support a more reliable neuraxial service [9].

## 8. Conclusions

Failed or inadequate labour epidural analgesia remains a multifactorial challenge shaped by maternal, obstetric, technical and organisational determinants. A structured approach grounded in the ESAIC PICO framework provides a coherent pathway for early recognition, standardised troubleshooting and timely re-siting when necessary. Evidence emphasises the importance of optimal catheter placement, secure fixation, consistent training and efficient interdisciplinary communication to minimise block failure and improve maternal satisfaction. Ultimately, effective management of failed epidural analgesia extends beyond catheter manipulation alone and requires system-level preparedness, clinical vigilance and adherence to evidence-based guidelines to ensure safe and reliable neuraxial care throughout labour.

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*The data supporting the findings of this study are derived from previously published sources. No new datasets were generated or analyzed. Additional information is available from the corresponding author upon reasonable request.*

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***Author Contributions***

***Selvinaz Yüksel Tanrıverdi:*** *conceptualization, data curation, formal analysis, investigation, methodology, supervision, validation, visualization, writing - original draft, writing – review & editing.*
***İlknur Hatice Akbudak:*** *data curation, methodology, validation, visualization, writing – original draft.*

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