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LOW-CONCENTRATION CONTINUOUS EPIDURAL LEVOBUPIVACAINE 0.125% WITH FENTANYL AS THE ANALGESIC BACKBONE OF AN ERACS-LIKE EARLY MOBILISATION PATHWAY AFTER REPEAT CAESAREAN DELIVERY IN A RURAL TYPE D HOSPITAL IN A DISADVANTAGED, BORDER AND ISLAND (DTPK) REGION OF INDONESIA: A CASE REPORT AND LITERATURE REVIEW

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ABSTRACT

Introduction: Caesarean delivery is associated with moderate-to-severe postoperative pain, which is frequently accentuated after repeat caesarean delivery and may delay mobilisation, breastfeeding and discharge. Enhanced recovery after caesarean section (ERACS) pathways place opioid-sparing multimodal analgesia and early mobilisation at their core, yet published experience from rural,

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resource-limited hospitals in Indonesia's disadvantaged, border and island (*Daerah Tertinggal, Perbatasan dan Kepulauan*, DTPK) regions is scarce. We describe an ERACS-like pathway anchored on low-concentration continuous epidural levobupivacaine combined with fentanyl in a Type D hospital.

Case report: A 22-year-old woman (G2P1001) at 37–38 weeks' gestation with one previous caesarean delivery (2024) presented with latent-phase labour, clinically suspected cephalopelvic disproportion and prelabour rupture of membranes of <24 h. Admission haematology, bleeding and clotting times and infection serology were unremarkable (haemoglobin 13.3 g/dL; platelets $251 \times 10^3/\mu\text{L}$). She was classified as ASA physical status II and underwent repeat caesarean delivery under neuraxial anaesthesia; an epidural catheter was retained for continuous postoperative analgesia with levobupivacaine 0.125% plus fentanyl 100 μg , supplemented by scheduled paracetamol and ketorolac. The visual analogue scale (VAS) pain score decreased from 5 at 4 h to 3 at 8 h, 2 at 17 h, 1 at 32 h and 0 at approximately 48 h, with a Bromage score of 0 at every assessment. She walked to the bathroom with assistance at 8 h, independently at 17 h, and was ready for discharge on postoperative day 2 without pruritus, postoperative nausea and vomiting or prolonged urinary retention.

Discussion: Levobupivacaine, the S(–)-enantiomer of bupivacaine, provides near-equivalent analgesic potency with a wider cardiovascular and central nervous system safety margin. At low concentration, its sensory-predominant block, potentiated by the predominantly spinal, supra-additive action of epidural fentanyl, allows effective analgesia without clinically detectable motor block. Continuous delivery yields steady-state analgesia that is particularly relevant after repeat caesarean delivery, a recognised risk factor for more severe acute pain. Safe implementation in a Type D hospital requires protocolised respiratory, haemodynamic and neurological surveillance, preparedness for local anaesthetic systemic toxicity, and alignment of the remaining ERACS elements, notably early urinary catheter removal, liberal clear-fluid intake, fluid and antimicrobial stewardship.

Conclusion: Low-concentration epidural levobupivacaine–fentanyl analgesia, embedded in multimodal care, was a feasible and well-tolerated analgesic backbone for early mobilisation after repeat caesarean delivery in a rural Type D hospital. Prospective protocolised evaluation using internationally agreed ERAC core outcomes is warranted before wider adoption.

Keywords: levobupivacaine; epidural analgesia; enhanced recovery after caesarean section; early ambulation; resource-limited settings

INTRODUCTION

Background

Caesarean delivery is the most frequently performed major operation in women worldwide. An estimated 29.7 million births (21.1%) occurred by caesarean section in 2015, almost double the figure for 2000, with pronounced within-country disparities between wealth quintiles, urban and rural residence and public and private facilities. In Indonesia, the national caesarean rate rose from 1.6% in 1991 to 17.6% in 2017; higher rates are concentrated in western Indonesia, whereas eastern provinces continue to record lower rates and widening absolute inequalities, reflecting unequal access to comprehensive emergency obstetric and anaesthetic care (Boerma et al., 2018; Zahroh et al., 2020).

The safety of caesarean delivery in low- and middle-income countries (LMICs) remains a pressing concern. A meta-analysis of 196 studies from 67 LMICs estimated a maternal mortality of 7.6 per 1,000 caesarean procedures, and a quarter of all maternal deaths occurred in women who had undergone caesarean section. In the African Surgical Outcomes Study, peri-operative

anaesthetic complications were independently associated with maternal death (odds ratio 11.47), in a setting with a combined density of specialist surgeons, obstetricians and anaesthetists of only 0.7 per 100,000 population. These data underscore that anaesthetic quality, not merely access to surgery, determines maternal outcome in resource-limited environments (Sobhy et al., 2019; Bishop et al., 2019).

Post-caesarean pain is typically moderate to severe and has consequences that extend beyond patient discomfort: inadequate analgesia impairs early mobilisation, breastfeeding, maternal–infant bonding and patient satisfaction, and severe acute pain on movement within the first 24 h is the most consistent predictor of chronic post-surgical pain, which affects approximately 18% of women at 3 months and 7% at 12 months in prospective cohorts (Roofthoof et al., 2021; Jin et al., 2016; Yimer et al., 2019).

Women undergoing repeat caesarean delivery constitute a particularly vulnerable subgroup. In a retrospective analysis of 1,899 women receiving neuraxial anaesthesia, repeat caesarean delivery was independently

associated with greater postoperative pain severity (odds ratio 1.54), and in a resource-limited Ethiopian cohort a history of previous caesarean section increased the odds of moderate-to-severe pain within 24 h almost three-fold (adjusted odds ratio 2.80). Previous caesarean delivery has also been identified as a risk factor for persistent pain at 3 months. In Indonesia, a cross-sectional study reported moderate pain in 60% and severe pain in 30% of women 12 h after caesarean section, illustrating the local burden of undertreated post-caesarean pain (Mehdiratta et al., 2020; Bimrew et al., 2022; Wang et al., 2018; Atmawan et al., 2023).

Enhanced recovery after caesarean delivery (termed ERAC in the Society for Obstetric Anesthesia and Perinatology [SOAP] literature and ERACS in Indonesian clinical practice) comprises a bundle of evidence-based pre-, intra- and postoperative interventions designed to optimise maternal recovery. Core postoperative elements include scheduled paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs), early oral intake, early mobilisation, early discontinuation of intravenous fluids, early removal of the urinary catheter and venous thromboembolism prophylaxis (Bollag et al.,

2021; Wilson et al., 2018; Macones et al., 2019; Wilson et al., 2025).

The clinical impact of ERAC implementation has been synthesised in several meta-analyses. Pooled data from 19,001 women showed a reduction in length of hospital stay of approximately 14 h and lower opioid consumption without an increase in readmissions or maternal complications; another synthesis of randomised and observational studies reported shorter hospital stay, lower pain scores (weighted mean difference -1.23) and fewer postoperative complications; and an expanded meta-analysis of 18,368 subjects confirmed faster times to first mobilisation, oral intake and urinary catheter removal (Pinho et al., 2023; Meng et al., 2021; Lestari et al., 2024).

Within ERAC, the choice of neuraxial analgesic technique is pivotal. International recommendations favour a single dose of long-acting intrathecal morphine combined with regular paracetamol and NSAIDs, with fascial plane blocks or wound infiltration where neuraxial morphine is not used. However, preservative-free morphine may be unavailable in some settings, and neuraxial opioids mandate structured respiratory monitoring that is

labour-intensive; expert commentators have cautioned against uncritically transferring monitoring recommendations derived in high-resource environments to low-resource maternity units. In such circumstances, a continuous low-concentration epidural infusion of a local anaesthetic with a lipophilic opioid represents a pragmatic alternative, and network meta-analytic data suggest that epidural fentanyl provides better early analgesia and less nausea and sedation than intravenous morphine patient-controlled analgesia after caesarean section (Roofthoof et al., 2021; Crowe et al., 2026; ASA and ASRA, 2016; Wong and Dyer, 2019; Chang et al., 2022).

Levobupivacaine, the pure S(-)-enantiomer of racemic bupivacaine, was developed specifically to reduce the cardiotoxicity attributed predominantly to the R(+)-enantiomer. Its analgesic and anaesthetic profile closely resembles that of bupivacaine, while in vitro, animal and human volunteer studies consistently demonstrate a lower propensity for cardiac and central nervous system toxicity. When combined with epidural fentanyl, the minimum local analgesic concentration of levobupivacaine is approximately halved, enabling dilute solutions that preserve motor

function (Foster and Markham, 2000; Heppolette et al., 2020; Casati and Putzu, 2005; Robinson et al., 2001).

Indonesia's health system classifies public and private general hospitals into types A to D according to service capability, with Type D hospitals providing only basic specialist services. Many such hospitals serve disadvantaged, border and island (*Daerah Tertinggal, Perbatasan dan Kepulauan, DTPK*) communities in which geographical isolation, limited specialist staffing and constrained monitoring capacity coexist. National survey data confirm significant regional disparities in hospital utilisation, and global workforce surveys report physician anaesthesia provider densities below the recommended minimum of 5 per 100,000 population in 76 countries. Limited availability of functional monitors and anaesthesia staff has been documented as a barrier to safe obstetric anaesthesia across comparable settings (Laksono et al., 2023; Law et al., 2024; Kempthorne et al., 2017; Epiu et al., 2017).

Nevertheless, adapted enhanced recovery programmes have proved feasible in resource-limited environments. A randomised trial of emergency caesarean deliveries in Uganda reduced length of stay

by 18.5 h, implementation in a regional hospital in Bhutan increased day-2 discharges from 2.3% to 81%, a tailored programme in a South African public hospital improved Obstetric Quality of Recovery-10 scores, and a meta-analysis of LMIC studies confirmed shorter hospital stay with enhanced recovery. Conversely, audits from resource-limited hospitals indicate that overall ERAC practice frequently falls below target, particularly for postoperative elements such as early urinary catheter removal (Baluku et al., 2020; Tamang et al., 2021; van Niekerk et al., 2025; Riad et al., 2023; Ibrahim et al., 2023).

Research Gap

Four gaps justify the present report. First, the evidence base underpinning ERAC recommendations derives predominantly from high-income, tertiary institutions, and systematic reviews rate the certainty of evidence as low or very low with heterogeneous interventions and outcomes; guidance from LMIC and rural secondary-level hospitals remains limited (Sultan et al., 2020; Riad et al., 2023).

Second, procedure-specific analgesic recommendations for caesarean section are built around intrathecal morphine and explicitly exclude unplanned or intrapartum

caesarean deliveries, leaving uncertainty about the optimal analgesic backbone where long-acting neuraxial opioids are unavailable or their monitoring cannot be reliably delivered (Roofthoof et al., 2021; Crowe et al., 2026; Wong and Dyer, 2019).

Third, much of the quantitative pharmacodynamic evidence for levobupivacaine–fentanyl combinations, including minimum local analgesic concentration studies, originates from labour analgesia rather than from post-caesarean infusions, and data specifically addressing women with a previous caesarean scar—who experience more intense acute pain—are sparse (Robinson et al., 2001; Lyons et al., 1997; Mehdiratta et al., 2020; Landau et al., 2025).

Fourth, in our Consensus-based search of the peer-reviewed literature, we did not identify a published case report describing an ERACS-like early mobilisation pathway supported by continuous epidural levobupivacaine–fentanyl analgesia after repeat caesarean delivery in a Type D hospital in an Indonesian DTPK region. Documentation of such real-world experience is therefore needed to inform locally adapted protocols (Gagnier et al., 2013; Riley et al., 2017).

Novelty

The novelty of this report lies in the convergence of three elements that are rarely described together: (i) a patient with a previous caesarean scar undergoing repeat caesarean delivery after prelabour rupture of membranes in latent labour; (ii) an analgesic strategy based on low-concentration (0.125%) continuous epidural levobupivacaine with fentanyl rather than intrathecal morphine; and (iii) delivery of ERACS-like milestones—assisted ambulation within 8 h, independent ambulation by 17 h and discharge readiness on postoperative day 2—in a rural Type D hospital in eastern Indonesia. In addition, the report provides a structured audit of each ERAC element against international recommendations and proposes pragmatic adaptations for comparable facilities (Bollag et al., 2021; Wilson et al., 2025; Sultan et al., 2022).

Objectives

General objective. To describe the peri-operative course, analgesic efficacy, functional recovery and safety of an ERACS-like pathway anchored on continuous low-concentration epidural levobupivacaine–fentanyl analgesia after repeat caesarean delivery in a rural Type D hospital, and to

interpret these findings in the light of current evidence (Gagnier et al., 2013; Riley et al., 2017).

Specific objectives. (1) To characterise the temporal trajectory of pain intensity (VAS) and motor function (Bromage score) during the first 48 postoperative hours; (2) to document the timing of functional recovery milestones, namely assisted ambulation, independent ambulation and discharge readiness; (3) to report analgesia-related adverse effects, including pruritus, postoperative nausea and vomiting and urinary retention; (4) to review the pharmacological rationale for levobupivacaine and opioid–local anaesthetic synergy; and (5) to appraise the feasibility, safety requirements and limitations of implementing ERACS elements in a Type D DTPK hospital (Sultan et al., 2022; Bollag et al., 2021).

Hypothesis

As this is a single-patient descriptive report, no statistical hypothesis was tested. The working clinical hypothesis was that a continuous epidural infusion of levobupivacaine 0.125% with fentanyl, integrated with scheduled non-opioid analgesics, would (i) reduce pain to within the patient-acceptable symptom state (VAS

≤3.3/10) within the first postoperative evening, (ii) produce no clinically detectable motor block (Bromage score 0), (iii) permit ambulation on the day of surgery and discharge readiness by postoperative day 2, and (iv) do so without clinically significant opioid- or local anaesthetic-related adverse effects in a woman with a previous caesarean scar managed in a resource-limited hospital (Myles et al., 2017; Robinson et al., 2001; Wilson et al., 2025).

Benefits of the Report

Clinical benefit. The report offers anaesthesiologists and obstetricians practising in rural and remote settings a reproducible analgesic model that prioritises motor-sparing analgesia and early mobilisation after repeat caesarean delivery, together with explicit safety prerequisites (Bollag et al., 2021; Neal et al., 2018).

Institutional benefit. The ERAC element audit provides a practical template from which Type D hospitals may develop standing orders, nursing competency requirements and quality indicators aligned with international core outcome sets (Sultan et al., 2022; Ibrahim et al., 2023).

Academic benefit. The integrated literature review consolidates pharmacological, clinical and health-system

evidence for residents and specialists, and identifies research priorities such as prospective comparison of epidural and systemic multimodal regimens in Indonesian district hospitals (Riad et al., 2023; Chang et al., 2022).

Health-policy benefit. By documenting achievable enhanced recovery outcomes in a DTPK hospital, the report supports investment in anaesthesia workforce, essential equipment and drugs, and protocol-driven maternity care in underserved regions (Law et al., 2024; Zahroh et al., 2020).

CASE REPORT

Patient Information

A 22-year-old Indonesian woman, gravida 2, para 1, with one living child (G2P1001), was admitted to the emergency department of Rumah Sakit St. Gabriel Kewapante, a Type D hospital serving Sikka Regency, Flores, East Nusa Tenggara, on 11 July 2026 at 23:56 Central Indonesian Time (WITA, UTC+8). She reported intermittent abdominal and lower-back pain accompanied by a bloody show and leakage of turbid fluid per vaginam since 18:00 on the same day, i.e. approximately 6 h before admission.

Her last menstrual period was 22 October 2025, and the ultrasound-estimated

date of delivery was 29 July 2026; both dating methods were concordant, corresponding to a gestational age of 37 weeks and 3 days at admission. Her obstetric history comprised one previous caesarean delivery in 2024, which yielded a live-born infant weighing 2,600 g; the current pregnancy therefore followed an inter-delivery interval of less than 24 months. She had used oral contraceptive pills for 2 months after her previous delivery. She denied diabetes mellitus, cardiac disease, asthma, hypertension and thyroid disease, and her family history was negative for diabetes mellitus, cardiac disease, asthma and hypertension. No history of bleeding

diathesis, anticoagulant use or previous anaesthetic complications was recorded.

Clinical Findings on Admission

On admission she was in good general condition and fully conscious (compos mentis). Vital signs were stable, and obstetric examination showed a cephalic presentation with an unengaged fetal head, a reassuring fetal heart rate and irregular mild contractions. Vaginal examination revealed a cervical dilatation of 1 cm with absent membranes, consistent with prelabour rupture of membranes during the latent phase of the first stage of labour. The admission findings are summarised in Table 1

Table 1. Clinical findings on admission (11 July 2026, 23:56 WITA)

Domain	Parameter	Finding
General	General condition / consciousness	Good / compos mentis
Vital signs	Blood pressure	116/83 mmHg
	Heart rate	99 beats/min
	Respiratory rate	20 breaths/min
	Axillary temperature	36.6 °C
	Peripheral oxygen saturation (SpO ₂)	98% (room air)
Abdominal examination	Symphysis–fundal height	28 cm
	Fetal lie / presentation / back	Longitudinal / cephalic / right
	Engagement	Head not yet engaged (above pelvic inlet)
	Fetal heart rate	155 beats/min

	Uterine contractions	1 in 10 min, lasting 5–10 s
Vaginal examination	Cervical dilatation	1 cm
	Membranes	Absent (ruptured)
Working diagnosis	—	G2P1001, 37–38 weeks, singleton live fetus, cephalic; previous caesarean delivery (2024); latent phase of first stage of labour; clinical cephalopelvic disproportion; prelabour rupture of membranes <24 h

Diagnostic Assessment

Laboratory investigations performed in the emergency department are summarised in Table 2. Haemoglobin concentration, leucocyte and platelet counts were within the reference ranges. The haematocrit (36.8%) was flagged as low against the laboratory's narrow reference interval (40–42%), and the mean corpuscular haemoglobin (33.3 pg) and mean corpuscular haemoglobin concentration (36.1 g/dL) were marginally above the reference limits; in the context of a normal haemoglobin concentration and normocytic indices, these findings were not considered clinically significant, and a mildly elevated MCHC is more consistent with an analytical or haematocrit-derived artefact than with a haematological disorder. The leucocyte count of 10,100/ μ L was within the

normal range for late pregnancy and, together with a normal temperature, did not suggest chorioamnionitis.

Blood group was O. The bedside clotting time (7.55 min) and bleeding time (3.00 min) were within the laboratory reference limits. Hepatitis B surface antigen was non-reactive, and screening tests for human immunodeficiency virus and syphilis (VDRL) were negative. Prothrombin time, activated partial thromboplastin time and fibrinogen were not available. In a healthy parturient without a bleeding history, hypertensive disorder or anticoagulant exposure, a platelet count of $251 \times 10^3/\mu$ L placed her far above the threshold of $70 \times 10^3/\mu$ L at which the risk of spinal epidural haematoma is considered very low; no

contraindication to neuraxial anaesthesia or epidural catheterisation was identified.

Table 2. Admission laboratory results, retyped verbatim from the report issued by

the Laboratory of Rumah Sakit St. Gabriel Kewapante, Maumere, Flores, East Nusa Tenggara (emergency department; registration dated 11 July 2026)

Investigation	Result	Unit	Reference range	Flag	Clinical interpretation
HAEMATOLOGY — Complete blood count					
Haemoglobin	13.3	g/dL	12–15		Normal; adequate oxygen-carrying reserve before surgery
Leucocytes	10,100	/ μ L	4,300–11,300		Normal for late pregnancy; no leucocytosis suggestive of chorioamnionitis
Erythrocytes	4.00	$\times 10^6/\mu$ L	3.9–4.82		Normal
Platelets	251	$\times 10^3/\mu$ L	150–400		Normal; no platelet-related contraindication to neuraxial block
Haematocrit (HCT/PCV)	36.8	%	40–42	*	Below the laboratory's narrow interval; consistent with physiological haemodilution of pregnancy
Segmented neutrophils	68.0	%	50–70		Normal
Lymphocytes	21.3	%	20–40		Normal
MCV	92.0	fL	80–100		Normocytic
MCH	33.3	pg	26–32	*	Marginally high; not clinically significant
MCHC	36.1	g/dL	32–36	*	Marginally high; probable analytical (haematocrit-derived) artefact
MXD (mixed cells)	10.7	%	1.3–25.9		Normal

BLOOD GROUP					
ABO blood group	O	—	—		Documented for transfusion readiness
HAEMOSTASIS SCREENING					
Clotting time (CT)	7.55 [confirm: 7 min 55 s?]	min	2–8		Within reference limits
Bleeding time (BT)	3.00	min	1–5		Within reference limits
IMMUNOLOGY AND SEROLOGY					
HBsAg	Non-reactive	—	Non-reactive		Negative
HIV (reagent 1)	Negative	ug/ng (as printed)	Negative		Negative (single-reagent screening)
VDRL	Negative	—	Negative		Negative

Obstetric Assessment and Decision for Repeat Caesarean Delivery

The obstetric team diagnosed latent-phase labour with prelabour rupture of membranes of less than 24 h in a woman with one previous caesarean delivery, an unengaged fetal head and clinically suspected cephalopelvic disproportion. Considering the short inter-delivery interval, the unengaged presenting part, the clinical suspicion of disproportion and the need for immediate availability of emergency operative, anaesthetic and blood-bank capacity throughout any trial of labour, repeat caesarean delivery was planned for 11:00 WITA on 12 July 2026 on the morning

operating list. The obstetric record classified the procedure as urgent (*cito*) in the postoperative note, whereas the admission plan described it as scheduled.

Pre-anaesthetic Evaluation and Preparation

At the pre-anaesthetic visit on the morning of 12 July 2026 the patient was in good general condition and fully conscious, with a blood pressure of 120/80 mmHg, heart rate 82 beats/min, respiratory rate 16 breaths/min and SpO₂ 98% on room air. She was classified as American Society of Anesthesiologists (ASA) physical status II on account of pregnancy.

Pre-operative instructions comprised fasting from solid food for 6 h, with sips of plain water permitted until 2 h before surgery; intravenous Ringer's lactate at 1,500 mL per 24 h; oral paracetamol 1,000 mg (two tablets) with a sip of water 2 h before surgery as pre-emptive analgesia; continuation of obstetric therapy as prescribed; and transfer to the operating theatre 30 min before the scheduled start. The pre-operative and postoperative orders are summarised in Table 3

Anaesthetic and Surgical Management

Repeat caesarean delivery was performed under neuraxial anaesthesia, and an epidural catheter was left in situ at the end of surgery for postoperative analgesia. Based on the documented postoperative time points (the first pain assessment at 16:31 WITA being recorded as 4 h after surgery), surgery was completed at approximately 12:30 WITA, and the postoperative obstetric orders were issued at 12:34 WITA. At that time the fundus was two finger-breadths below the umbilicus with a well-contracted uterus, there was no abnormal vaginal bleeding, and an indwelling urinary catheter was in place;

the postoperative diagnosis was P2002, post-caesarean delivery day 0

2.8 Postoperative Analgesic Regimen and ERACS-Like Care Orders

Postoperative analgesia was delivered as a continuous epidural infusion of levobupivacaine 0.125% to which fentanyl 100 µg had been added. This was combined with scheduled systemic non-opioid analgesia comprising intravenous ketorolac 30 mg every 8 h and paracetamol 500 mg four times daily, in keeping with the multimodal, opioid-sparing principle of enhanced recovery (Roofthoof et al., 2021; Bollag et al., 2021; Chou et al., 2016).

The obstetric orders further included an infusion of Ringer's lactate containing oxytocin 20 IU at approximately 28 drops/min for 12 h, intravenous tranexamic acid 1 g every 8 h diluted in 100 mL of 0.9% sodium chloride, intravenous cefotaxime 1 g every 8 h, an indwelling urinary catheter for 24 h, and resumption of oral fluids and food without further fasting as soon as the patient could move her legs. Mobilisation was to proceed in graded steps: turning to the right and left, sitting, and then walking (Table 3).

Table 3. Peri-operative orders relevant to anaesthesia, analgesia and enhanced recovery

Phase	Order (as documented)	Enhanced-recovery rationale
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Pre-operative	Solid fasting 6 h; sips of water up to 2 h before surgery	Limits fasting; ERAS permits clear fluids up to 2 h and a light meal up to 6 h
	Ringer's lactate 1,500 mL/24 h	Maintenance of euvolaemia while fasting
	Oral paracetamol 1,000 mg 2 h pre-operatively	Pre-emptive component of multimodal analgesia
	Transfer to theatre 30 min before surgery	Process timing
Intra-operative	Neuraxial anaesthesia; epidural catheter retained [details]	Avoids general anaesthesia; enables postoperative neuraxial analgesia
Postoperative analgesia	Continuous epidural levobupivacaine 0.125% + fentanyl 100 µg [volume/rate]	Motor-sparing, steady-state neuraxial analgesia
	Ketorolac 30 mg IV every 8 h	Scheduled NSAID (opioid-sparing)
	Paracetamol 500 mg four times daily	Scheduled paracetamol (dose optimisable)
Uterotonic / haemostasis	Ringer's lactate + oxytocin 20 IU, ~28 drops/min for 12 h	Maintenance of uterine tone
	Tranexamic acid 1 g IV every 8 h in 100 mL NaCl 0.9%	Antifibrinolytic (see Discussion 3.10)
Antimicrobial	Cefotaxime 1 g IV every 8 h	Infection prophylaxis/treatment (see Discussion 3.10)
Nutrition	Oral intake permitted once legs can be moved; no fasting	Early oral intake
Bladder	Indwelling urinary catheter for 24 h	Early removal recommended by ERAS (see Table 8)
Mobilisation	Graded: turn right/left → sit → walk	Early mobilisation

Abbreviations: ERAS, Enhanced Recovery After Surgery Society; IV, intravenous; NSAID, non-steroidal anti-inflammatory drug.

Postoperative Monitoring, Follow-up and Outcomes

Pain intensity was assessed with a 0–10 visual analogue scale and lower-limb motor function with the Bromage score (0 = full movement of hips, knees and ankles; 3 = complete motor block). The sequence of events is displayed in Figure 1, and the pain and functional trajectory in Table 4 and Figure 2

At 16:31 WITA on the day of surgery (approximately 4 h postoperatively), the patient complained of lower abdominal and lower-back pain; her general condition was moderate, she was fully conscious, the VAS score was 5 and the Bromage score was 0, and she remained in bed. By 20:30 WITA (approximately 8 h), pain had diminished to

a VAS score of 3 with a Bromage score of 0, and she was able to walk to the bathroom supported by a family member.

On postoperative day 1 at 05:00 WITA (approximately 17 h), she reported markedly reduced pain (VAS 2) and walked to the bathroom independently without support. At 20:45 WITA on the same day (approximately 32 h), her pain had further improved (VAS 1), her general condition was good and she was comfortable. On the morning of postoperative day 2 (approximately 48 h), she had no complaints, her VAS score was 0 and her general condition was good; she was considered ready for discharge. The Bromage score was 0 at every reported assessment (Macones et al., 2019; Wilson et al., 2025).

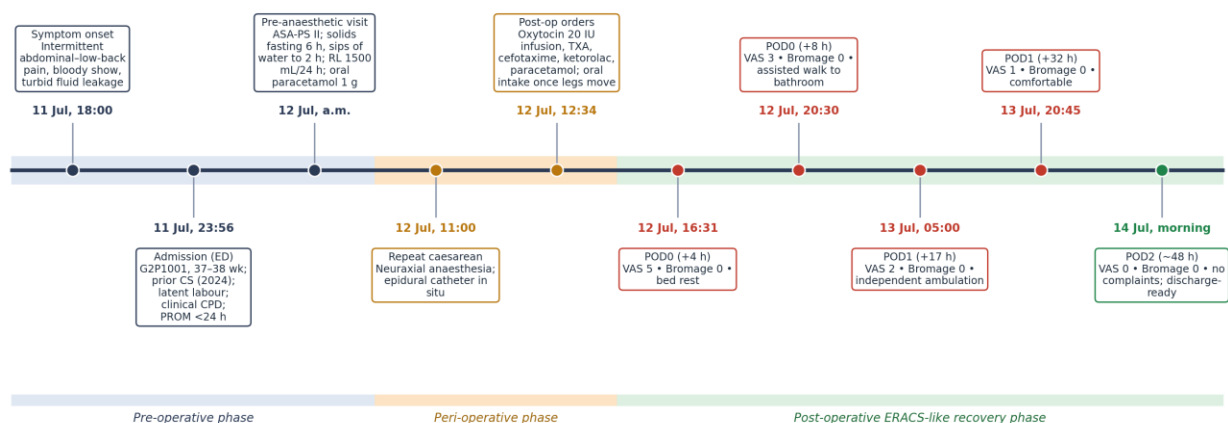


Figure 1. Clinical timeline from symptom onset to discharge readiness (clock times in Central Indonesian Time, WITA). Events are spaced ordinally rather than to scale. CPD, cephalopelvic

disproportion; CS, caesarean section; ED, emergency department; POD, postoperative day; PROM, prelabour rupture of membranes; RL, Ringer's lactate; TXA, tranexamic acid; VAS, visual analogue scale.

Table 4. Postoperative pain assessment and functional recovery

Time point (clock time, WITA)	Elapsed time after surgery	VAS (0–10)	Bromage score (0–3)	Clinical status / activity
POD0, 16:31	≈4 h	5	0	Moderate pain (lower abdomen and lower back); bed rest
POD0, 20:30	≈8 h	3	0	Mild pain; walked to bathroom with assistance of a family member
POD1, 05:00	≈17 h	2	0	Pain much reduced; independent ambulation to bathroom
POD1, 20:45	≈32 h	1	0	Minimal pain; comfortable; good general condition
POD2, morning	≈48 h	0	0	No complaints; ready for discharge

Abbreviations: POD, postoperative day; VAS, visual analogue scale; WITA, Central Indonesian Time. Elapsed times are approximate, derived from the documented time points.

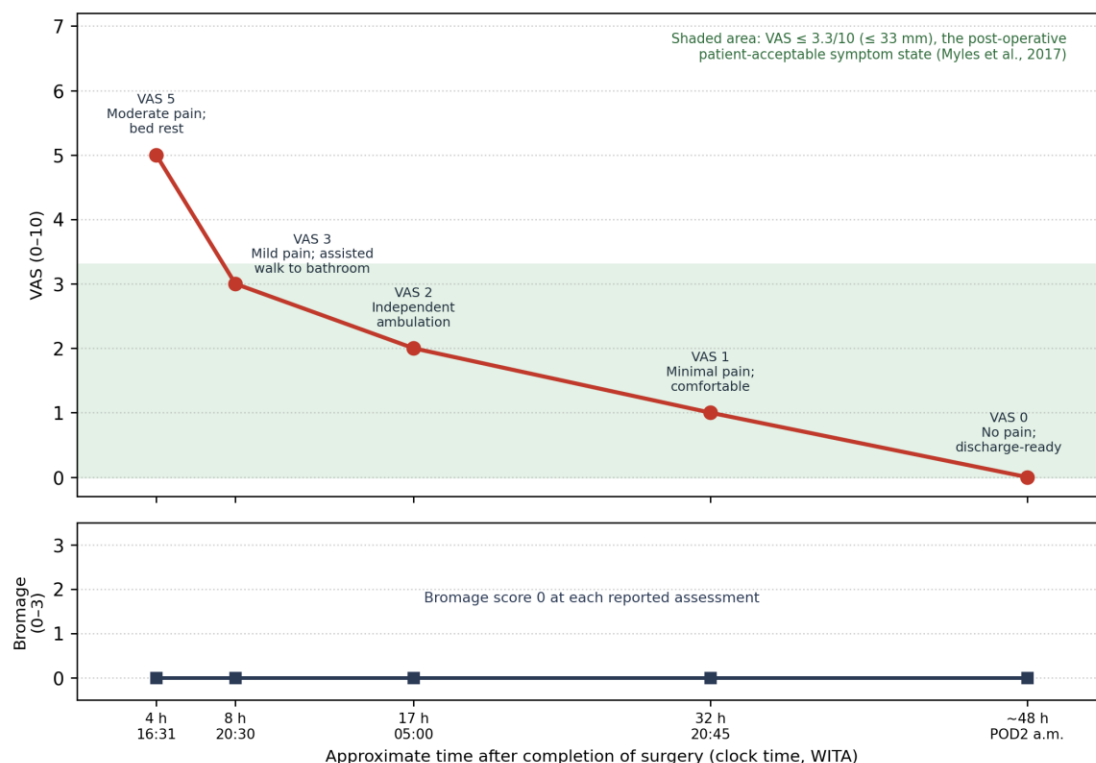


Figure 2. Trajectory of pain intensity (upper panel, VAS 0–10) and lower-limb motor function (lower panel, Bromage score 0–3) during the first 48 postoperative hours, annotated with functional milestones. The shaded band indicates VAS $\leq 3.3/10$ (≤ 33 mm), the postoperative patient-acceptable symptom state described by Myles et al. (2017).

Adverse Event Surveillance

Throughout the monitoring period, the patient did not develop severe pruritus, postoperative nausea or vomiting, or prolonged urinary retention. No clinical features suggestive of respiratory depression, excessive sedation, local anaesthetic systemic toxicity, post-dural puncture headache, or new neurological deficit were recorded. The surveillance findings are summarised in Table 5.

Table 5. Surveillance for analgesia-related adverse effects

Adverse effect	Observed	Comment
Pruritus	Not observed (no severe pruritus)	Dose-dependent with epidural fentanyl; favoured by dilute concentrations

Postoperative nausea and vomiting	Not observed	Lower odds with epidural fentanyl than with IV morphine PCA
Urinary retention	No prolonged retention reported	Interpretation confounded by indwelling catheter for 24 h [time of removal and first void]
Motor block / fall	Bromage 0; no falls	Assisted first ambulation at $\approx$ 8 h
Respiratory depression / sedation	Not reported [verify charts]	Lipophilic opioid; monitoring required during infusion
Hypotension	Not reported [verify charts]	Sympathetic block less marked at low concentration
Local anaesthetic systemic toxicity	Not observed	Low cumulative dose; S(-)-enantiomer
Neurological complications / headache	Not reported [verify]	Epidural haematoma and abscess are rare but require surveillance

Discharge and Patient Perspective

The patient was considered ready for discharge on the morning of postoperative day 2. She expressed a high level of satisfaction with her pain control and with the ability to walk and care for herself and her newborn early after surgery.

DISCUSSION

Summary of Principal Findings

This report describes a young woman with one previous caesarean delivery who underwent repeat caesarean delivery in a rural Type D hospital and received continuous epidural levobupivacaine 0.125% with fentanyl as the backbone of multimodal postoperative analgesia. Pain decreased monotonically from moderate (VAS 5) at 4 h to mild (VAS 3) at 8 h and to zero by approximately 48 h, while motor function remained intact (Bromage 0) at every assessment. These conditions allowed

assisted ambulation on the evening of surgery, independent ambulation within 17 h and discharge readiness on postoperative day 2, without clinically significant pruritus, nausea, vomiting or prolonged urinary retention. The outcomes are consistent with the functional milestones targeted by contemporary enhanced recovery recommendations (Bollag et al., 2021; Wilson et al., 2025; Sultan et al., 2022).

The subsequent sections discuss, in turn, the pharmacological properties that make levobupivacaine suited to this role, the synergy between epidural fentanyl and local

anaesthetic, the interpretation of the pain and motor trajectories, the particular analgesic needs of women with a previous caesarean scar, the position of epidural analgesia relative to alternative techniques, and the practical and safety requirements for delivering ERACS-like care in a resource-limited DTPK hospital (Chestnut et al., 2019; Gropper et al., 2020).

Pharmacological Advantages of Levobupivacaine: The “Goldilocks” Effect

The metaphor of a “Goldilocks” agent captures the balance sought in obstetric neuraxial analgesia: a local anaesthetic that is potent and long-acting enough to provide durable analgesia at low concentration, yet with a toxicity margin wide enough to tolerate the prolonged infusions, repeated boluses and inadvertent intravascular exposure that are inherent to epidural techniques. Racemic bupivacaine offers potency and duration but carries a disproportionate cardiotoxic risk, whereas less potent agents require higher concentrations that may increase motor block or total drug exposure. Levobupivacaine occupies an intermediate position—neither too toxic nor too weak—which is the pharmacological basis for its selection in this

case (Casati and Putzu, 2005; Burlacu and Buggy, 2008; Heppolette et al., 2020).

Stereochemistry and mechanism of action (pharmacodynamics)

Bupivacaine is a long-acting amino-amide local anaesthetic containing a chiral carbon; the commercial racemate is an equimolar mixture of the R(+)-enantiomer (dextrobupivacaine) and the S(−)-enantiomer (levobupivacaine). Like all local anaesthetics, levobupivacaine diffuses across the neuronal membrane in its un-ionised form and, once re-protonated in the axoplasm, binds to a receptor site within the pore of voltage-gated sodium channels, preferentially in their open and inactivated states. The resulting reduction in sodium influx raises the threshold for excitation, slows conduction and, when a critical length of axon is exposed, abolishes action potential propagation. Local anaesthetics additionally modulate potassium, calcium and hyperpolarisation-activated channels, ligand-gated channels and G-protein-coupled receptors, which may contribute to their clinical profile (Lirk, Hollmann and Strichartz, 2018; Gropper et al., 2020).

Levobupivacaine is highly protein bound, extensively metabolised in the liver and excreted in urine and faeces, with

pharmacokinetic properties that are broadly similar to those of bupivacaine. Its onset after epidural administration is within about 15 min, with dose-dependent duration; importantly for obstetric practice, epidural levobupivacaine produces motor block of shorter duration than sensory block. In a randomised trial of epidural anaesthesia for caesarean delivery, 0.5% levobupivacaine provided anaesthesia equivalent to that of 0.5% bupivacaine, with similar maternal plasma concentrations and an umbilical-to-maternal venous concentration ratio of approximately 0.3, indicating limited placental transfer relevant to neonatal exposure (Foster and Markham, 2000; Heppolette et al., 2020; Bader et al., 1999).

Concentration-dependent differential block

Differential block—the preferential loss of nociception and temperature sensation with relative preservation of touch, proprioception and motor power—is clinically exploited in obstetric epidural analgesia. The classical “size principle”, which postulated that thin fibres are intrinsically more sensitive to local anaesthetics, has not been confirmed experimentally: isolated nerve studies have shown that large, fast-conducting A fibres may be blocked at lower concentrations than

small C fibres, indicating that intrinsic axonal sensitivity alone cannot explain the clinical phenomenon (Gissen, Covino and Gregus, 1980; Lirk, Hollmann and Strichartz, 2018).

A more convincing explanation derives from the geometry of saltatory conduction. Impulses can traverse two consecutive blocked nodes of Ranvier but not three. In epidural blockade the local anaesthetic bathes only a few millimetres of the segmental nerve within the intervertebral foramen; consequently, a three-node block is likely in small fibres with short internodal distances but rare in large motor fibres with long internodes when dilute solutions are used, which accounts for the retention of motor power during low-concentration obstetric epidural analgesia. Quantitative sensory testing further demonstrates that A-beta, A-delta and C-fibre functions recover at different rates after neuraxial block, producing a temporal sequence of differential recovery (Fink, 1989; Liu et al., 1995).

The concentration used in this patient, 0.125% (1.25 mg/mL), is one-quarter of the 0.5% concentration used for surgical epidural anaesthesia at caesarean delivery. In labour, the median effective (minimum local analgesic) concentration of epidural levobupivacaine was 0.091% when given

alone and approximately 0.047–0.050% when combined with fentanyl 2–3 µg/mL. Although labour-derived values cannot be transposed directly to incisional pain after caesarean section, these data indicate that 0.125% with fentanyl lies comfortably above the median effective analgesic concentration while remaining in the dilute range

associated with minimal motor block—a pharmacological window that is consistent with the combination of effective analgesia and a Bromage score of 0 observed in this case; the proposed mechanistic basis is illustrated in Figure 3 (Bader et al., 1999; Robinson et al., 2001; Foster and Markham, 2000).

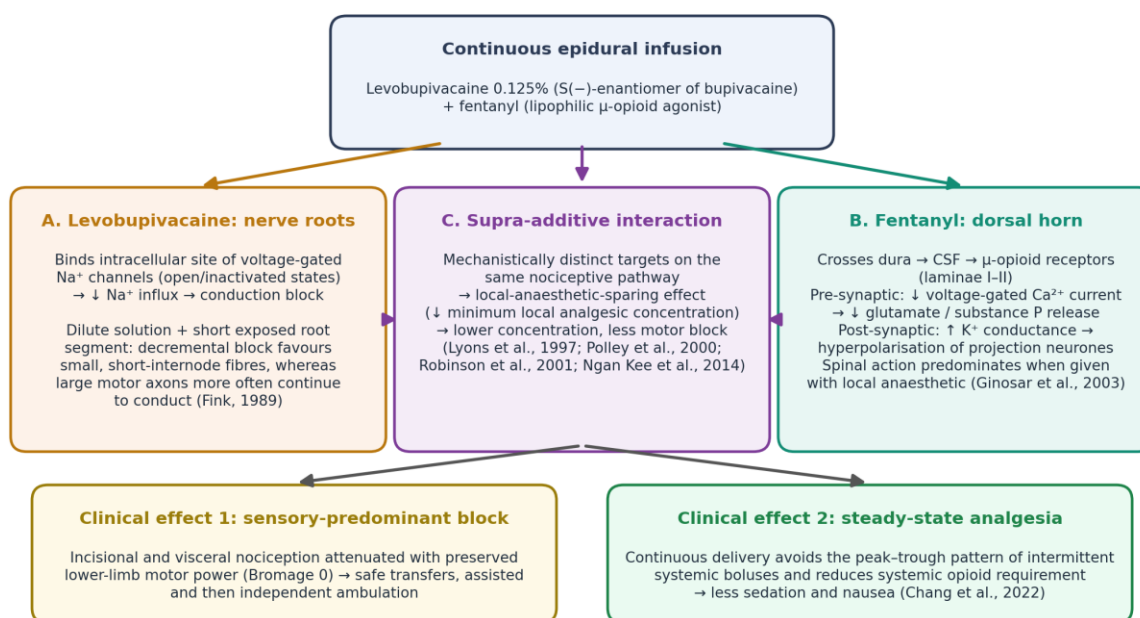


Figure 3. Proposed mechanistic basis of the analgesic regimen. (A) Levobupivacaine blocks voltage-gated sodium channels in the segmental nerve roots; at low concentration, decremental conduction block preferentially affects small, short-internode fibres. (B) Epidural fentanyl reaches spinal µ-opioid receptors in the dorsal horn, reducing presynaptic neurotransmitter release and hyperpolarising postsynaptic neurones. (C) Acting at distinct sites on the same nociceptive pathway, the two drugs interact supra-additively, reducing the local anaesthetic concentration required and thereby limiting motor block. The clinical corollaries are sensory-predominant, steady-state analgesia that permits early ambulation. LA, local anaesthetic; CSF, cerebrospinal fluid; LAST, local anaesthetic systemic toxicity; MLAC, minimum local analgesic concentration.

Safety profile: cardiotoxicity and central nervous system toxicity

Bupivacaine cardiotoxicity arises principally from high-affinity, slowly dissociating blockade of cardiac sodium channels, with additional effects on potassium and calcium handling, producing QRS widening, re-entrant ventricular arrhythmias and myocardial depression that may be refractory to resuscitation. This toxicity is enantioselective and more pronounced with the R(+)-enantiomer; levobupivacaine displays lower affinity for cardiac sodium and potassium channels. Across isolated tissue and whole-animal models, the intravascular dose of levobupivacaine required to cause death has consistently been higher than that of bupivacaine; in awake sheep, approximately 78% more levobupivacaine was required to cause death (Mather and Chang, 2001; Gristwood, 2002).

In a crossover study in conscious sheep, doses above 75 mg of bupivacaine and 100 mg of levobupivacaine induced QRS widening and ventricular arrhythmias, but three animals died of sudden ventricular fibrillation after 150–200 mg of bupivacaine, whereas the same doses of levobupivacaine produced non-fatal arrhythmias that reverted

spontaneously. In anaesthetised swine receiving intracoronary injections, the median lethal dose was 0.015 mmol for racemic bupivacaine, 0.028 mmol for levobupivacaine and 0.032 mmol for ropivacaine, corresponding to cardiotoxic potency ratios of 2.1:1.2:1 (Huang et al., 1998; Morrison et al., 2000).

Human volunteer data corroborate these findings. During intravenous infusion to the onset of central nervous system symptoms, levobupivacaine produced significantly smaller reductions in stroke index (−5.14 versus −11.86 mL/m²), acceleration index and ejection fraction than racemic bupivacaine at comparable plasma concentrations, and electroencephalographic evidence of central nervous system depression was less marked. Nevertheless, levobupivacaine should be regarded as “safer” rather than “safe”: systemic toxicity remains possible, pregnancy is recognised as a physiological state of increased susceptibility, and every facility using epidural infusions must be prepared to recognise and treat local anaesthetic systemic toxicity with airway management, seizure control, modified advanced life support and 20% lipid emulsion (Bardsley et al., 1998; Foster and Markham, 2000; Mather and

Chang, 2001; Macfarlane et al., 2021; Neal et al., 2018).

Relative potency and comparison with alternative long-acting agents

Comparative minimum local analgesic concentration studies indicate a modest potency hierarchy of bupivacaine > levobupivacaine > ropivacaine, with relative potency ratios of 0.77:0.83:1.00 in early labour; these differences are small compared with the four-fold reduction in local anaesthetic requirements produced by adding an epidural opioid. Some authors have questioned the strict equipotency of levobupivacaine and bupivacaine and warned

that compensatory dose escalation could erode the motor-sparing advantage of the S(–)-enantiomer. In practice, the choice between levobupivacaine and ropivacaine in a given facility is often determined by availability and cost rather than by clinically meaningful efficacy differences, but both are preferable to racemic bupivacaine when the risk of systemic toxicity is non-trivial, as with prolonged epidural infusions; key comparative properties are summarised in Table 6 (Buyse et al., 2006; Burlacu and Buggy, 2008; Casati and Putzu, 2005; Gristwood, 2002).

Table 6. Comparative pharmacology of long-acting amide local anaesthetics relevant to obstetric epidural analgesia

Property	Racemic bupivacaine	Levobupivacaine	Ropivacaine
Stereochemistry	50:50 mixture of R(+) and S(–) enantiomers	Pure S(–)-enantiomer of bupivacaine	Pure S(–)-enantiomer (propyl homologue)
Relative analgesic potency (epidural MLAC ratio, early labour)	0.77 (most potent)	0.83	1.00 (least potent)
Effect of epidural opioid on LA requirement	Marked reduction (fentanyl dose-dependent)	MLAC $\approx$ halved with fentanyl 2–3 μ g/mL	Marked reduction (opioid-dependent)
Cardiotoxic potency ratio (swine, lethal intracoronary dose)	2.1	1.2	1.0

Ventricular fibrillation at high IV doses (sheep)	Fatal VF at 150–200 mg	Non-fatal, self-terminating arrhythmias at same doses	—
Negative inotropy in volunteers	Greater (stroke index -11.86 mL/m^2)	Less (stroke index -5.14 mL/m^2)	Similar to levobupivacaine in volunteer comparison
Motor block profile (epidural)	Dense at higher concentrations	Motor block shorter than sensory block	Least motor block at equipotent doses
Practical role in this case	—	0.125% + fentanyl continuous infusion	Alternative where available

Abbreviations: IV, intravenous; LA, local anaesthetic; MLAC, minimum local analgesic concentration; VF, ventricular fibrillation. Sources: Buyse et al. (2006); Robinson et al. (2001); Morrison et al. (2000); Huang et al. (1998); Bardsley et al. (1998); Foster and Markham (2000); Casati and Putzu (2005).

Synergy between Opioid and Local Anaesthetic

Epidural opioids and local anaesthetics act at mechanistically distinct sites on the nociceptive pathway. Local anaesthetics interrupt axonal conduction in the nerve roots, whereas opioids that reach the spinal cord bind μ -opioid receptors in the superficial dorsal horn, inhibiting presynaptic voltage-gated calcium channels to reduce the release of excitatory neurotransmitters and activating postsynaptic potassium conductance to hyperpolarise second-order neurones. Combining the two therefore attenuates nociceptive transmission at more

than one level, allowing each drug to be used at a lower dose (Chestnut et al., 2019; Gropper et al., 2020).

The local anaesthetic-sparing effect of epidural fentanyl has been quantified with the minimum local analgesic concentration model. Fentanyl 1, 2, 3 and 4 $\mu\text{g/mL}$ reduced the minimum local analgesic concentration of epidural bupivacaine by 18%, 31%, 55% and 72%, respectively, in a significant dose-dependent manner, although pruritus increased significantly at 4 $\mu\text{g/mL}$. For levobupivacaine specifically, fentanyl 2 $\mu\text{g/mL}$ and 3 $\mu\text{g/mL}$ reduced the minimum local analgesic concentration from 0.091% to

0.047% and 0.050%, respectively (Lyons et al., 1997; Robinson et al., 2001).

The site of fentanyl action in these combinations is predominantly spinal rather than systemic. When administered epidurally with bupivacaine, fentanyl increased the analgesic potency of the local anaesthetic 1.88-fold compared with the same dose given intravenously, and during continuous infusion epidural fentanyl was more than three times as potent as intravenous fentanyl. At the intrathecal level, formal dose-response analysis has demonstrated that the interaction between fentanyl and bupivacaine is synergistic—that is, greater than predicted by simple additivity—providing a theoretical foundation for the combination used in this patient (Polley et al., 2000; Ginosar et al., 2003; Ngan Kee et al., 2014).

Clinical studies of postoperative epidural analgesia support the relevance of this synergy beyond labour. In women undergoing gynaecological oncological surgery, 0.125% levobupivacaine with fentanyl 2 µg/mL required fewer rescue epidural boluses and less supplementary paracetamol than an equivalent bupivacaine-fentanyl mixture. After caesarean section, dilute levobupivacaine or ropivacaine solutions delivered by patient-controlled

epidural analgesia provided satisfactory pain relief, and a network meta-analysis found that epidural fentanyl produced lower pain scores at 4 and 8 h, and lower odds of nausea and vomiting (odds ratio 0.27) and sedation (odds ratio 0.22), than intravenous morphine patient-controlled analgesia, albeit with more pruritus (Shobha et al., 2023; Matsota et al., 2011; Chang et al., 2022).

The contribution of the opioid should nevertheless not be overstated. In a randomised trial after caesarean section, plain epidural levobupivacaine 0.1% provided analgesia comparable to that of levobupivacaine 0.06% with fentanyl 2 µg/mL, suggesting that an opioid-free epidural solution may be a reasonable option when opioid-related adverse effects or monitoring constraints are a concern. The choice of fentanyl concentration therefore represents a trade-off between local anaesthetic sparing on the one hand and pruritus and respiratory surveillance requirements on the other (Chen et al., 2014; Lyons et al., 1997; Carvalho, 2008).

Interpretation of the VAS Trajectory

The minimal clinically important difference for the 100-mm VAS after surgery is approximately 10 mm (1 point on a 0–10 scale), and a score of 33 mm or less

corresponds to a patient-acceptable symptom state. Against these benchmarks, the fall from VAS 5 at 4 h to VAS 3 at 8 h represents a clinically meaningful improvement, and every subsequent value lay within the acceptable symptom state. The progressive decline to 0 by postoperative day 2 therefore indicates adequate and sustained analgesia once the infusion had reached steady state (Myles et al., 2017).

The VAS of 5 recorded at 4 h, however, exceeded the acceptable threshold and deserves critical interpretation. Plausible contributors include regression of the dense intra-operative neuraxial block before the dilute infusion had established full segmental analgesia, visceral pain from uterine contraction augmented by the postoperative oxytocin infusion, and the lower-back component of the pain, which may reflect positional discomfort or referred visceral pain. This observation suggests that a protocolised transition—for example, a loading bolus at the end of surgery, an explicit epidural top-up when VAS is ≥ 4 , or programmed intermittent epidural boluses, which reduced motor block and local anaesthetic consumption compared with continuous infusion in labour—could further smooth the early analgesic trajectory

(Capogna et al., 2011; Landau et al., 2025; Roofthoof et al., 2021).

Two caveats apply. First, it was not documented whether pain was scored at rest or on movement; pain on movement is more relevant to functional recovery and is the stronger predictor of chronic post-surgical pain. Second, the scheduled ketorolac and paracetamol almost certainly contributed to the trajectory, so the relative contribution of the epidural component cannot be isolated in a single case (Jin et al., 2016; Sultan et al., 2022).

Correlation between Analgesia and the Bromage Score

The persistent Bromage score of 0 despite effective analgesia is the clinical expression of the sensory-predominant block described above and is concordant with trials of dilute local anaesthetic–opioid infusions in which motor block was minimal or absent. The absence of motor block is a prerequisite for safe early ambulation, early oral intake—which in this patient was explicitly linked to the ability to move her legs—and independent self-care and infant care (Foster and Markham, 2000; Capogna et al., 2011; Macones et al., 2019).

The Bromage scale is, however, a coarse instrument. In patients recovering

from spinal anaesthesia, only 30% were able to walk unassisted at the moment their Bromage score returned to 0, and quantitative dynamometry of knee, hip and ankle strength predicted safe unassisted ambulation considerably better. In an audit of postoperative epidural analgesia with bupivacaine 0.1% and fentanyl 2 µg/mL, lower-limb motor weakness developed in 36.5% of patients, more frequently with lumbar catheters. A Bromage score of 0 should therefore be complemented by functional tests (for example, straight-leg raising against resistance, a partial knee bend and a supervised standing test) before the first walk, and the first ambulation should be supervised by trained staff rather than by family members alone (Al-metwalli et al., 2013; Ahmed et al., 2016).

Early Mobilisation as a Functional Outcome

Early mobilisation and ambulation is a strongly recommended component of postoperative enhanced recovery after caesarean delivery. Its expected benefits include a reduced risk of venous thromboembolism, earlier return of bowel function, improved pulmonary mechanics, facilitation of breastfeeding and maternal–infant bonding, and shorter hospital stay.

Time to first mobilisation is included in the internationally agreed core outcome set for enhanced recovery studies (Wilson et al., 2025; Bollag et al., 2021; Sultan et al., 2022). In the present case, assisted ambulation occurred approximately 8 h and independent ambulation approximately 17 h after surgery, followed by discharge readiness at about 48 h. These milestones compare favourably with the reductions in time to first mobilisation and length of stay reported in meta-analyses of ERAC implementation, and with the 81% day-2 discharge rate achieved after enhanced recovery implementation in a regional hospital in Bhutan. They are particularly notable in a woman who had undergone a repeat operation and who might otherwise have been expected to experience more intense pain (Lestari et al., 2024; Meng et al., 2021; Tamang et al., 2021; Mehdiratta et al., 2020).

Pain Management in Patients with a Previous Caesarean Scar

Women with a previous caesarean scar present a more complex analgesic challenge. Repeat operation may involve dense peritoneal and abdominal-wall adhesions, longer dissection and operative time, and handling of fibrotic scar tissue, all of which increase tissue injury and

inflammatory nociceptive input. Repeat caesarean delivery has been recognised as a factor associated with greater intra-operative and postoperative pain that should prompt enhanced analgesic strategies, including prolonged epidural analgesia with local anaesthetic solutions or repeated epidural morphine (Landau et al., 2025; Mehdiratta et al., 2020).

Epidemiological data reinforce this concern. Previous caesarean section increased the odds of moderate-to-severe pain within the first 24 h almost three-fold in a resource-limited cohort, and previous caesarean delivery together with higher analgesic consumption at 24–48 h predicted persistent pain at 3 months after elective caesarean delivery. Because more intense acute pain on movement independently predicts chronic post-surgical pain at 3, 6 and 12 months, effective control of early dynamic pain in this population is relevant not only to immediate recovery but potentially to long-term outcome (Bimrew et al., 2022; Wang et al., 2018; Jin et al., 2016; Yimer et al., 2019).

Continuous epidural analgesia offers a pharmacokinetic advantage in this setting. Intermittent systemic boluses of non-opioid analgesics such as ketorolac or metamizole produce fluctuating plasma concentrations

with potential breakthrough pain at trough levels, whereas a continuous neuraxial infusion maintains a relatively constant segmental block (steady state) at the spinal level where nociceptive input from the incision and uterus converges. In a randomised trial, adding patient-controlled epidural levobupivacaine 0.167% to intrathecal morphine significantly reduced pain at rest and on movement for up to 24 h after caesarean section without delaying ambulation, supporting the concept that a dilute epidural local anaesthetic can close the analgesic gap on movement (Sato et al., 2020; Chang et al., 2022).

In our patient, pain declined steadily from 5 to 0 without documented rescue analgesia, which is consistent with this steady-state concept. Nonetheless, this pattern reflects the combined effect of the epidural infusion and the scheduled NSAID and paracetamol regimen, which are themselves strongly recommended cornerstones of post-caesarean analgesia, and it cannot be attributed to the epidural component alone (Roofthoof et al., 2021; Wilson et al., 2025).

**Position of Continuous Epidural
Analgesia Relative to Contemporary
Alternatives**

Current procedure-specific recommendations for elective caesarean section under neuraxial anaesthesia prioritise intrathecal morphine 50–100 µg (or diamorphine) administered pre-operatively, combined with paracetamol, NSAIDs and intravenous dexamethasone after delivery. When a neuraxial opioid is not used, wound infiltration, continuous wound infusion or fascial plane blocks such as the transversus abdominis plane, quadratus lumborum or erector spinae plane blocks are recommended, with opioids reserved for rescue. Continuous epidural infusion is not a first-line recommendation in these guidelines (Roofthoof et al., 2021; Crowe et al., 2026).

Comparative trials illustrate why. Intrathecal morphine provided better analgesia than patient-controlled epidural ropivacaine–sufentanil after caesarean section, and a prospective cohort reported better quality of recovery with an intravenous tramadol–ondansetron infusion than with epidural ropivacaine analgesia, together with fewer adverse effects. Reviews also note that

epidural analgesia, although effective, may hinder early recovery through motor block, hypotension, catheter-related tethering to infusion devices and increased nursing workload (Kaufner et al., 2016; Jimenez-Santana et al., 2025; Mostafa et al., 2025).

Conversely, epidural techniques retain important advantages in selected contexts. They allow titration of analgesia over several days, avoid the delayed respiratory depression profile of long-acting hydrophilic opioids, and permit earlier recovery of ambulation and bowel function in some comparisons. Where an epidural catheter has already been placed—for example, when combined spinal–epidural or epidural anaesthesia is used for surgery—where preservative-free morphine or ultrasound-guided block expertise is unavailable, or where the patient is at high risk of severe pain, as after repeat caesarean delivery, a low-concentration epidural local anaesthetic–lipophilic opioid infusion is a rational, context-appropriate choice. A synthesis of the most relevant studies is provided in Table 7 (Paech et al., 2000; Carvalho, 2008; Landau et al., 2025; Wong and Dyer, 2019).

Table 7. Summary of selected evidence relevant to the present case

Study	Design / setting	Key finding	Relevance to the present case
Robinson et al. (2001)	Double-blind up–down sequential allocation; labour (n = 106)	MLAC of levobupivacaine 0.091% alone; 0.047% with fentanyl 2 µg/mL	0.125% + fentanyl lies above the median effective concentration yet remains dilute
Lyons et al. (1997)	Double-blind sequential allocation; labour (n = 223)	Fentanyl 1–4 µg/mL reduced bupivacaine MLAC by 18–72%; pruritus increased at 4 µg/mL	Opioid–LA sparing; dilute fentanyl limits pruritus
Ngan Kee et al. (2014)	RCT with dose-equivalence analysis; labour (n = 300)	Intrathecal fentanyl–bupivacaine interaction is synergistic	Mechanistic basis for combination
Chang et al. (2022)	Network meta-analysis; 23 RCTs, post-caesarean (n = 2,589)	Epidural fentanyl: lower VAS at 4 and 8 h, less PONV and sedation than IV morphine PCA; more pruritus	Supports epidural lipophilic opioid for early analgesia
Sato et al. (2020)	RCT; elective caesarean (n = 50)	Adding epidural levobupivacaine 0.167% to intrathecal morphine lowered NRS at rest/movement up to 24 h; ambulation not delayed	Dilute epidural levobupivacaine is motor-sparing after caesarean
Chen et al. (2014)	Double-blind RCT; post-caesarean PCEA (n = 80)	Levobupivacaine 0.1% alone comparable to 0.06% + fentanyl 2 µg/mL	Opioid-free epidural solution is an alternative
Shobha et al. (2023)	RCT; gynaecological oncology (n = 70)	Levobupivacaine 0.125% + fentanyl 2 µg/mL needed fewer rescue	Same levobupivacaine concentration as present case

		boluses than bupivacaine–fentanyl	
Kaufner et al. (2016)	RCT; elective caesarean (n = 199)	Intrathecal morphine superior to PCEA ropivacaine–sufentanil	Counter-evidence; epidural is not universally superior
Mehdiratta et al. (2020)	Retrospective cohort (n = 1,899)	Repeat caesarean independently associated with more severe pain (OR 1.54)	Justifies enhanced analgesia after previous caesarean
Al-metwalli et al. (2013)	Prospective study after spinal anaesthesia (n = 20)	At Bromage 0, only 30% could walk unassisted	Functional testing needed before ambulation
Baluku et al. (2020)	RCT; emergency caesarean, Uganda (n = 160)	Enhanced recovery reduced length of stay by 18.5 h; less severe pain	ERAC feasible in low-resource setting
Lestari et al. (2024)	Systematic review and meta-analysis (23 studies; 18,368 subjects)	ERAC shortened hospital stay and times to mobilisation, oral intake and catheter removal	Benchmarks for recovery milestones

Abbreviations: IV, intravenous; LA, local anaesthetic; MLAC, minimum local analgesic concentration; NRS, numeric rating scale; OR, odds ratio; PCA, patient-controlled analgesia; PCEA, patient-controlled epidural analgesia; PONV, postoperative nausea and vomiting; RCT, randomised controlled trial; VAS, visual analogue scale.

Supporting the ERACS Concept in a Resource-Limited Setting: RS St. Gabriel Kewapante (DTPK, Type D Hospital)

Delivering enhanced recovery in a Type D hospital within a DTPK region is constrained by structural factors that differ fundamentally from those of the tertiary

centres in which ERAC protocols were developed. The global density of physician anaesthesia providers is 6.6 per 100,000 population, with 76 countries below the minimum of 5 per 100,000, and anaesthesia workforce and equipment shortages are most severe in rural and remote facilities. Surveys

of referral hospitals in comparable settings found that no facility met all requirements for safe obstetric anaesthesia, that functional monitors were often unavailable, and that only a small minority reported adequate anaesthesia staffing (Law et al., 2024; Kempthorne et al., 2017; Epiu et al., 2017).

In Indonesia, geographical and regional disparities in hospital utilisation and caesarean access persist, and eastern provinces have historically lower caesarean rates. Improving the quality of peri-operative care at the first operative level of the referral system is therefore as important as expanding access. Professional bodies emphasise that anaesthesia services should be available in all hospitals offering maternity care and that appropriately educated nursing staff, under physician supervision, can safely participate in the management of epidural infusions—a principle that is essential where a single anaesthesiologist may cover the entire hospital (Laksono et al., 2023; Zahroh et al., 2020; ACOG, 2019b).

Within these constraints, this case illustrates that several high-impact ERAC elements depend more on protocol and team culture than on expensive technology: limited fasting, pre-emptive oral paracetamol, neuraxial anaesthesia, scheduled NSAID and

paracetamol, early oral intake and graded early mobilisation. Experience from Uganda, Bhutan, South Africa and pooled LMIC data confirms that adapted enhanced recovery pathways are feasible and shorten hospital stay without increasing complications, although practice audits show that postoperative elements are often incompletely implemented (Baluku et al., 2020; Tamang et al., 2021; van Niekerk et al., 2025; Riad et al., 2023; Ibrahim et al., 2023).

A structured comparison of the care delivered with international recommendations (Table 8) identifies elements that were implemented, adapted, partially implemented or not documented. The most important opportunities for improvement are early removal of the urinary catheter, liberalisation of clear fluids up to 2 h before surgery with consideration of a carbohydrate drink, earlier discontinuation of intravenous fluids, explicit prophylaxis against nausea and spinal hypotension, documented venous thromboembolism risk assessment, and antimicrobial and antifibrinolytic regimens aligned with the evidence. The specific challenges of the Type D setting and suggested mitigation strategies are summarised in Table 9 (Wilson et al.,

2018; Caughey et al., 2018; Wilson et al., 2025; Bollag et al., 2021).

Table 8. Audit of ERAC elements in the present case against international recommendations

Phase	Recommended element	Care delivered in this case	Status	Suggested adaptation
Pre-op	Antenatal education and counselling	Not documented	Not documented	Simple written/visual ERACS information in local language
Pre-op	Clear fluids up to 2 h; light meal up to 6 h; carbohydrate drink	Solids 6 h; sips of water only up to 2 h	Partial	Allow unrestricted clear fluids to 2 h; sweetened clear drink if no carbohydrate product
Pre-op	Haemoglobin screening and optimisation	Hb 13.3 g/dL documented	Implemented	Routine antenatal Hb check
Pre-op	Pre-emptive non-opioid analgesia	Oral paracetamol 1 g 2 h pre-op	Implemented	Retain
Pre-op	Aspiration prophylaxis	Not documented	Not documented	Oral H2-receptor antagonist or antacid
Intra-op	Neuraxial anaesthesia	Neuraxial anaesthesia with epidural catheter	Implemented	Retain; document technique
Intra-op	Neuraxial opioid for postoperative analgesia	Continuous epidural fentanyl with levobupivacaine	Adapted	Consider intrathecal morphine where available and monitoring feasible

Intra-op	Antibiotic prophylaxis before skin incision	Postoperative cefotaxime 1 g every 8 h; pre-incision dose not documented	Partial / not documented	Single pre-incision dose; extend only for documented infection
Intra-op	Prevention of spinal hypotension, PONV prophylaxis, normothermia	Not documented	Not documented	Vasopressor protocol, antiemetic, warmed fluids and blankets
Intra-op	Delayed cord clamping and early skin-to-skin contact	Not documented	Not documented	Include in theatre checklist
Post-op	Scheduled paracetamol and NSAID	Paracetamol 500 mg four times daily; ketorolac 30 mg every 8 h	Implemented	Paracetamol 1 g every 6 h (maximum 4 g/day)
Post-op	Early oral intake	Once legs could be moved	Implemented	Offer fluids within 2 h if no contraindication
Post-op	Early mobilisation	Assisted $\approx$ 8 h; independent $\approx$ 17 h	Implemented	Supervised first ambulation after functional test
Post-op	Early urinary catheter removal	Catheter for 24 h	Not implemented	Time-limited removal with post-void monitoring, compatible with epidural infusion
Post-op	Early discontinuation of IV fluids	Oxytocin infusion for 12 h; RL 1,500 mL/24 h	Partial	Stop maintenance fluids once drinking

Post-op	VTE risk assessment and prophylaxis	Early ambulation; pharmacological prophylaxis not documented	Partial	Risk scoring; coordinate LMWH timing with epidural catheter
Post-op	Standardised rescue protocol for pain and side effects	Not documented	Not documented	Written epidural top-up, antiemetic, antipruritic and naloxone orders
Post-op	Breastfeeding support; discharge planning	Discharge readiness POD2; breastfeeding not documented	Partial	Lactation support; contraception and inter-pregnancy counselling

Abbreviations: Hb, haemoglobin; IV, intravenous; LMWH, low-molecular-weight heparin; NSAID, non-steroidal anti-inflammatory drug; POD, postoperative day; PONV, postoperative nausea and vomiting; RL, Ringer's lactate; VTE, venous thromboembolism. Recommendations synthesised from Bollag et al. (2021), Wilson et al. (2018), Caughey et al. (2018), Macones et al. (2019), Wilson et al. (2025) and Roofthoof et al. (2021).

Table 9. Challenges of delivering epidural-based ERACS in a Type D DTPK hospital and proposed mitigation strategies

Challenge	Mitigation strategy
Few anaesthesiologists; no dedicated acute pain service	Standing orders and pre-printed epidural prescription; anaesthesiologist-led daily review; telephone escalation pathway; nurse-led monitoring under physician supervision
High nurse-to-patient ratios on maternity wards	Simplified observation chart combining pain, sedation, respiratory rate, SpO ₂ , blood pressure, sensory level and Bromage score at fixed intervals; competency-based training of midwives and nurses

Limited continuous monitoring (pulse oximetry, capnography)	Prioritise pulse oximetry for patients receiving neuraxial opioids; use dilute lipophilic opioid concentrations; avoid concomitant systemic opioids and sedatives
Infusion devices and consumables	Dedicated, labelled epidural syringe drivers or disposable infusion devices; standardised pre-mixed concentration to reduce calculation errors
Risk of local anaesthetic systemic toxicity	LAST checklist and kit containing 20% lipid emulsion on the ward and in theatre; aspiration and test-dose protocols; maximal cumulative dose limits
Limited coagulation testing	Structured bleeding history and platelet count; interdisciplinary review if thrombocytopenia, hypertensive disorder or anticoagulant use
Geographical isolation and referral delay	Early recognition and escalation criteria for respiratory depression, hypotension and neurological deficit; teleconsultation link with referral hospital
Documentation gaps	Standardised ERACS data sheet incorporating the ERAC core outcome set (times to mobilisation, oral intake, catheter removal; PONV; satisfaction; ObsQoR-10); periodic audit

Abbreviations: DTPK, *Daerah Tertinggal, Perbatasan dan Kepulauan* (disadvantaged, border and island regions); LAST, local anaesthetic systemic toxicity; ObsQoR-10, Obstetric Quality of Recovery-10; SpO₂, peripheral oxygen saturation. Sources: Neal et al. (2018); ASA and ASRA (2016); Bauer et al. (2021); ACOG (2019b); Sultan et al. (2022).

Safety Considerations

Haemostatic assessment before neuraxial procedures. In a resource-limited laboratory, prothrombin time and activated partial thromboplastin time may not be routinely available. Current guidance does not require routine coagulation testing in healthy parturients and emphasises a focused bleeding history, with a platelet count where

clinically indicated; bleeding time and bedside whole-blood clotting time are not used as screening criteria in these recommendations. Interdisciplinary consensus concludes that the risk of spinal epidural haematoma is very low at platelet counts of $70 \times 10^3/\mu\text{L}$ or higher in the absence of other risk factors, and pooled data estimate an upper 95% confidence limit of

0.2% for epidural haematoma at counts of 70–100 × 10³/μL. With a platelet count of 251 × 10³/μL and no bleeding history, the patient was an appropriate candidate for epidural catheterisation (ASA and SOAP, 2016; Bauer et al., 2021; Lee et al., 2017).

Thromboprophylaxis and catheter management. If pharmacological thromboprophylaxis is prescribed after caesarean delivery, the timing of low-molecular-weight heparin administration must be coordinated with epidural catheter removal according to obstetric-specific consensus recommendations. In this case, venous thromboembolism prophylaxis relied on early ambulation, and a formal risk assessment should be documented in future protocols (Leffert et al., 2018; Wilson et al., 2025).

Respiratory surveillance. Although lipophilic opioids such as fentanyl carry a lower risk of delayed respiratory depression than hydrophilic morphine, early respiratory depression can occur, and continuous neuraxial opioid infusions require structured monitoring of ventilation, oxygenation and level of consciousness for the duration of the infusion, with supplemental oxygen and naloxone immediately available. Monitoring recommendations derived from high-

resource settings must be translated carefully to maternity wards with limited staffing, and patient risk stratification (for example, obesity, obstructive sleep apnoea or concomitant sedatives) should determine monitoring intensity (Carvalho, 2008; ASA and ASRA, 2016; Bauchat et al., 2019; Wong and Dyer, 2019).

Local anaesthetic systemic toxicity and neurological complications. Prevention of systemic toxicity relies on the lowest effective dose and concentration, incremental dosing, aspiration and test dosing, and immediate availability of lipid emulsion and a management checklist. Neuraxial haematoma and infection are rare in obstetrics (approximately 1 in 100,000–200,000), but new or progressive motor or sensory deficit, severe back pain or fever during epidural analgesia must trigger prompt evaluation; in this patient, the unchanged Bromage score of 0 provided reassurance but should be complemented by explicit neurological observations (Neal et al., 2018; Macfarlane et al., 2021; Vallejo et al., 2024).

Tranexamic acid. The patient received intravenous tranexamic acid 1 g every 8 h postoperatively. Tranexamic acid is an antifibrinolytic rather than an

anticoagulant and does not, in itself, contraindicate epidural catheter management. The evidence for prophylactic use at caesarean delivery, however, concerns predominantly a single 1-g dose around the time of cord clamping. In a trial of 11,000 women, prophylactic tranexamic acid did not reduce the composite of maternal death or transfusion, and a Cochrane review found little or no difference in estimated blood loss $\geq 1,000$ mL; an individual patient data meta-analysis of 54,404 women found a reduction in life-threatening bleeding without an increase in thromboembolic events. Repeated postoperative dosing in a woman without documented haemorrhage should therefore be reserved for clear indications and reviewed in local protocols (Pacheco et al., 2023; Rohwer et al., 2024; Ker et al., 2024).

Antimicrobial prophylaxis. ERAS recommendations support prophylactic antibiotics administered before skin incision. The postoperative course of intravenous cefotaxime every 8 h may have been prescribed in view of ruptured membranes; however, in the absence of clinical signs of intra-amniotic infection, prolonged postoperative antibiotic therapy is not an enhanced recovery element, and its rationale and duration should be explicitly documented

to support antimicrobial stewardship (Caughey et al., 2018; Bollag et al., 2021).

Obstetric Considerations: Repeat Caesarean Delivery versus Trial of Labour

Trial of labour after one previous low-transverse caesarean delivery is appropriate for many women, with vaginal birth achieved in approximately 60–80% and a uterine rupture risk of approximately 0.3–0.7%. Success is more likely with a previous vaginal birth, a non-recurrent indication for the first caesarean section, an inter-birth interval of at least 18 months, a body mass index below 30 kg/m² and spontaneous labour, and the facility must be able to perform an emergency caesarean delivery without delay. A previous caesarean section for cephalopelvic disproportion or dystocia is associated with lower odds of successful vaginal birth after caesarean (odds ratio 0.54) (ACOG, 2019a; Barnea et al., 2025; Wu et al., 2019).

In this patient, an inter-delivery interval of less than 24 months, an unengaged fetal head with clinically suspected disproportion, prelabour rupture of membranes and the logistical realities of a Type D hospital supported the decision for repeat caesarean delivery. Looking forward,

each additional caesarean delivery increases the risks of placenta praevia (odds ratio 1.74), placenta accreta spectrum (odds ratio 2.95) and stillbirth in subsequent pregnancies, underscoring the importance of postpartum contraceptive counselling, adequate inter-pregnancy spacing and early antenatal referral in any future pregnancy (Keag, Norman and Stock, 2018; Barnea et al., 2025).

Absence of Adverse Effects: Evidence of an “Optimal Dose”?

The absence of severe pruritus, nausea and vomiting and prolonged urinary retention is encouraging and consistent with the favourable adverse effect profile of dilute epidural fentanyl, which causes less nausea and sedation than systemic morphine and produces pruritus in a dose-dependent manner, particularly at concentrations of 4 µg/mL. It suggests that the regimen was well tolerated in this patient (Chang et al., 2022; Lyons et al., 1997).

However, a single case cannot establish an optimal dose. The fentanyl concentration and infusion rate were not documented in the available records, urinary retention was masked by an indwelling catheter for 24 h, and haemodynamic data were limited. Adverse effects of neuraxial

opioids are dose-related and vary between individuals, and dose-finding requires prospective studies with predefined outcomes. The appropriate conclusion is therefore that the regimen appeared effective and well tolerated, and that it provides a reasonable starting point for protocol development and prospective evaluation (Carvalho, 2008; Sultan et al., 2022; Robinson et al., 2001).

Strengths

The strengths of this report include structured documentation of pain and motor scores at clinically relevant intervals, clear functional milestones, a de-identified objective laboratory record, adherence to CARE reporting principles and an integrated review of pharmacological, clinical and health-system evidence retrieved from peer-reviewed sources (Gagnier et al., 2013; Riley et al., 2017).

Implications for Practice and Research

For practice, the case supports the development of a written ERACS bundle for Type D hospitals in which low-concentration epidural levobupivacaine with or without fentanyl is one of several analgesic options, selected according to catheter availability, drug supply, monitoring capacity and individual pain risk, and always combined

with scheduled paracetamol and NSAIDs. Protocols should incorporate the safety prerequisites discussed above and the omitted ERAC elements identified in the audit (Bollag et al., 2021; Roofthoof et al., 2021; Neal et al., 2018).

For research, prospective cohort studies or pragmatic randomised trials in Indonesian district hospitals should compare epidural local anaesthetic–opioid infusion, intrathecal morphine and fascial plane blocks within a common multimodal regimen, using the ERAC core outcome set—including time to mobilisation, time to urinary catheter removal, opioid requirement, nausea and vomiting, breastfeeding success, length of stay and ObsQoR-10—and including women with previous caesarean delivery as a prespecified subgroup (Sultan et al., 2022; Riad et al., 2023; Crowe et al., 2026).

CONCLUSION AND RECOMMENDATIONS

Conclusion

In a 22-year-old woman undergoing repeat caesarean delivery in a rural Type D hospital in an Indonesian DTPK region, continuous low-concentration epidural levobupivacaine 0.125% with fentanyl, integrated with scheduled paracetamol and ketorolac, provided effective, motor-sparing,

steady-state analgesia. Pain decreased from VAS 5 to 0 over 48 h with a Bromage score of 0 throughout, enabling assisted ambulation at 8 h, independent ambulation at 17 h and discharge readiness on postoperative day 2 without clinically significant adverse effects. The favourable balance between potency and systemic toxicity of levobupivacaine, together with the supra-additive spinal action of fentanyl, provides a coherent pharmacological explanation for these outcomes (Foster and Markham, 2000; Robinson et al., 2001; Wilson et al., 2025).

The case demonstrates that core ERACS objectives are achievable in a resource-limited setting when neuraxial analgesia is embedded within a multimodal, mobilisation-oriented pathway. It also shows that safe and complete implementation requires deliberate attention to monitoring, preparedness for rare but serious complications, and the less visible ERAC elements—particularly urinary catheter management, fluid, antimicrobial and antifibrinolytic stewardship—which are as important as the choice of analgesic technique (Bollag et al., 2021; Neal et al., 2018; Ibrahim et al., 2023).

Recommendations

Clinical. (1) Consider low-concentration epidural levobupivacaine (0.1–0.125%) with dilute fentanyl, or an opioid-free solution, when an epidural catheter is in place, particularly for women with a previous caesarean scar; (2) prescribe regular paracetamol at full dose and a scheduled NSAID unless contraindicated; (3) provide a loading or rescue epidural bolus protocol for VAS ≥ 4 ; (4) confirm motor function with functional testing and supervise the first ambulation; and (5) remove the urinary catheter early with post-void monitoring (Roofthoof et al., 2021; Al-metwalli et al., 2013; Wilson et al., 2025).

Institutional. RS St. Gabriel Kewapante and comparable Type D hospitals should (1) adopt written ERACS standing orders adapted from SOAP and ERAS recommendations; (2) train and credential ward nurses and midwives in epidural infusion monitoring; (3) maintain a local anaesthetic systemic toxicity kit with 20% lipid emulsion, naloxone and oxygen on maternity wards; (4) harmonise antibiotic and tranexamic acid protocols with current evidence; and (5) audit outcomes periodically using the ERAC core outcome set (Bollag et

al., 2021; ACOG, 2019b; Neal et al., 2018; Sultan et al., 2022).

Research. Prospective, multicentre evaluation in Indonesian district and DTPK hospitals is needed to compare analgesic strategies within ERACS pathways, to define optimal levobupivacaine and fentanyl concentrations and delivery modes (continuous infusion versus programmed intermittent bolus), and to assess chronic post-surgical pain and cost-effectiveness (Capogna et al., 2011; Riad et al., 2023; Jin et al., 2016).

Health policy. Strengthening the anaesthesia workforce, ensuring the availability of essential neuraxial drugs, infusion devices and monitoring equipment, and supporting teleconsultation networks between Type D hospitals and referral centres are prerequisites for scaling safe enhanced recovery care to underserved regions of Indonesia (Law et al., 2024; Laksono et al., 2023; Zahroh et al., 2020).

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