

Effect of Early Versus Late Epidural Analgesia on Labour Progress and Mode of Delivery: A Prospective Observational Study

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Abstract:

Background: Epidural analgesia is an effective method of pain relief during labour. However, the timing of epidural initiation has historically been debated because of concerns regarding its possible influence on labour progression and mode of delivery. Current evidence suggests that neuraxial analgesia does not need to be routinely delayed until a specific degree of cervical dilatation.

Aim: To evaluate the association of early versus late epidural analgesia with labour progress and mode of delivery.

Materials and Methods: A prospective observational study was conducted in the Department of Obstetrics and Gynaecology, DMCH, over a period of may 2025 to June 2026. A total of 100 women in labour who received epidural analgesia were recruited using consecutive sampling. Participants were categorized according to cervical dilatation at the time of epidural initiation. Women receiving epidural analgesia before 4 cm cervical dilatation constituted the early epidural group, while those receiving epidural analgesia at or after 4 cm constituted the late epidural group. Each group consisted of 50 participants. Labour progression, duration of the first and second stages, total duration of labour, oxytocin augmentation, mode of delivery, and selected maternal and neonatal outcomes were assessed. Continuous variables were compared using the independent-samples *t* test, while categorical variables were analysed using the chi-square test or Fisher's exact test, as appropriate. A *p* value <0.05 was considered statistically significant.

Results: The mean duration of the first stage of labour was significantly longer in the early epidural group than in the late epidural group (6.0 ± 1.5 vs 5.2 ± 1.4 hours; $p = 0.008$). The mean duration of the second stage was 55.2 ± 18.1 minutes in the early group and 51.0 ± 16.4 minutes in the late group, with no statistically significant difference ($p = 0.224$). Total labour duration was significantly longer in the early group (6.9 ± 1.6 vs 6.2 ± 1.5 hours; $p = 0.028$). Oxytocin augmentation was required in 28 (56.0%) women in the early group and 22 (44.0%) in the late group ($p = 0.230$). Spontaneous vaginal delivery occurred in 39 (78.0%) and 41 (82.0%) women, instrumental vaginal delivery in 5 (10.0%) and 4 (8.0%), and caesarean delivery in 6 (12.0%) and 5 (10.0%) women in the early and late groups, respectively. No statistically significant difference was observed in mode of delivery. Maternal and neonatal outcomes were also comparable between the groups.

Conclusion: In this prospective observational study, early epidural analgesia was associated with a modestly longer first stage and total duration of labour compared with late epidural analgesia. However, no statistically significant difference was observed in spontaneous vaginal, instrumental or caesarean delivery rates. These findings suggest that early epidural analgesia may be considered according to maternal preference and clinical circumstances rather than being routinely delayed solely on the basis of cervical dilatation. Larger prospective studies with adjustment for potential confounding factors are warranted.

Keywords: Epidural Analgesia; Labour Analgesia; Early Epidural; Late Epidural; Labour Progress; Mode Of Delivery; Caesarean Delivery; Vaginal Delivery.

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Introduction

Labour is a physiological process accompanied by pain of varying intensity. The perception of labour pain is influenced by uterine contractions, cervical dilatation, stretching of the lower genital tract, fetal position, maternal anxiety and individual psychological factors. Adequate pain relief is an important component of quality maternity care, and epidural analgesia is one of the most effective pharmacological methods for relieving pain during labour [1,2]. Evidence from randomized trials and systematic reviews indicates that epidural analgesia provides effective pain relief without a clear increase in the risk of caesarean delivery.

Despite its effectiveness, the timing of epidural analgesia has historically been debated because of concerns regarding its possible influence on labour progression and mode of delivery. Earlier clinical practice frequently recommended postponing neuraxial analgesia until cervical dilatation had reached a particular threshold. These concerns were based on the possibility that neuraxial blockade could influence uterine activity, maternal expulsive efforts and the duration of labour, potentially increasing the likelihood of instrumental or caesarean delivery [2,3].

Earlier reviews and clinical observations reported associations between epidural analgesia and prolongation of labour and increased use of operative vaginal delivery. These observations contributed to the traditional practice of delaying epidural analgesia during early labour. However, interpretation of these associations is complicated by the fact that women requesting analgesia earlier in labour may differ in important clinical characteristics from those requesting analgesia later [2,3].

Subsequent randomized trials questioned whether the timing of neuraxial analgesia itself was responsible for adverse obstetric outcomes. Wong et al., in a randomized trial involving 750 nulliparous women, compared an early neuraxial analgesia strategy with delayed epidural analgesia and found no significant increase in caesarean delivery with early neuraxial analgesia [4].

Similarly, another randomized trial involving 449 nulliparous women compared immediate epidural analgesia in women with cervical dilatation of less than 3 cm with delayed epidural analgesia until cervical dilatation reached at least 4 cm. Caesarean delivery rates were not significantly different between the early and late groups, and early initiation was not associated with an increase in instrumental vaginal delivery or other adverse obstetric outcomes [5].

The timing of neuraxial analgesia has also been investigated among women undergoing induction of

labour. Wong et al. evaluated early neuraxial analgesia in nulliparous women undergoing induction and found no significant difference in caesarean delivery compared with a strategy involving systemic opioid analgesia followed by later epidural analgesia [6]. In that trial, early neuraxial analgesia also provided better pain relief and was not associated with a longer duration of labour.

Further evidence was provided by a large randomized controlled trial involving 12,793 nulliparous women. Women receiving epidural analgesia during the latent phase were compared with those receiving delayed epidural analgesia. The study found no significant difference in caesarean delivery between the early and delayed groups and did not demonstrate prolongation of labour with early epidural administration [7].

Systematic review evidence has similarly challenged the need to delay neuraxial analgesia until a particular degree of cervical dilatation. A Cochrane review evaluating randomized trials of early versus late initiation of epidural analgesia included nine studies involving 15,752 women. The review assessed outcomes including caesarean delivery, instrumental birth and time to birth and did not demonstrate an important increase in adverse obstetric outcomes associated with early initiation [8].

The type and concentration of local anaesthetic used for epidural analgesia may also influence labour outcomes. Modern low-concentration epidural techniques are intended to provide effective analgesia while minimizing motor blockade. Evidence from randomized trials and systematic review data suggests that low-concentration epidural techniques are not associated with a clinically important increase in adverse obstetric outcomes [9].

The relationship between neuraxial analgesia and labour progression is multifactorial. Duration of labour and the second stage may be influenced by parity, induction of labour, oxytocin augmentation, fetal size and position, maternal characteristics and the management of pushing. Therefore, differences in labour duration between women receiving epidural analgesia at different stages of labour should not automatically be attributed to the timing of epidural administration alone.

Current recommendations have moved away from using a fixed cervical dilatation threshold as a prerequisite for neuraxial analgesia. The World Health Organization recommends epidural analgesia as an option for healthy pregnant women requesting pain relief during labour, taking individual preferences and clinical circumstances into account

[10]. Current ACOG guidance similarly supports neuraxial analgesia for maternal request during labour and does not require a specific cervical dilatation threshold before analgesia can be offered [11].

Although substantial evidence is available from randomized trials, prospective observational data remain useful because patient characteristics, obstetric management, analgesic protocols and clinical practices may vary between institutions. The present study was therefore undertaken to evaluate the association between early versus late epidural analgesia, labour progression and mode of delivery among women receiving obstetric care at DMCH.

Aim: To evaluate the effect of early versus late epidural analgesia on labour progress and mode of delivery.

Objectives

1. To compare the duration of the first stage of labour between women receiving early and late epidural analgesia.
2. To compare the duration of the second stage of labour between the two groups.
3. To compare spontaneous vaginal, instrumental and caesarean delivery rates between the groups.
4. To compare the requirement for oxytocin augmentation.
5. To compare selected maternal and neonatal outcomes between the groups.

Materials and Methods

Study Design and Setting: A prospective observational study was conducted in the Department of Obstetrics and Gynaecology, DMCH, over a period of May 2024 to June 2026. The study was undertaken to evaluate the association between the timing of epidural analgesia and labour progression and mode of delivery.

Study Population: Women admitted in labour who requested and received epidural analgesia during the study period were considered for enrolment. Eligible participants were categorized into two groups according to cervical dilatation at the time of initiation of epidural analgesia.

1. **Early epidural group:** Epidural analgesia initiated before 4 cm cervical dilatation.
2. **Late epidural group:** Epidural analgesia initiated at or after 4 cm cervical dilatation.

A total of 100 women were included in the study, with 50 women in each group.

Sampling Method

Consecutive sampling was used. All eligible women fulfilling the inclusion criteria during the study period were recruited consecutively until the

required sample size of 100 participants was achieved.

Inclusion Criteria: Women meeting all of the following criteria were included:

- Women admitted in labour.
- Singleton pregnancy.
- Live fetus.
- Cephalic presentation.
- Gestational age of ≥ 37 completed weeks.
- Women requesting epidural analgesia for labour pain.
- Women receiving epidural analgesia during labour.
- Women willing to participate in the study.
- Written informed consent obtained before enrolment.

Exclusion Criteria: Women with any of the following were excluded:

1. Multiple pregnancy.
2. Non-cephalic presentation.
3. Placenta previa or significant antepartum haemorrhage.
4. Contraindication to neuraxial analgesia.
5. Major maternal medical or obstetric complications likely to influence labour management.
6. Known major fetal anomaly affecting the planned mode of delivery.
7. Planned elective caesarean delivery.
8. Incomplete or inadequate clinical records.

Study Group Classification: Participants were divided into two groups based on cervical dilatation at the time of epidural initiation.

Women who received epidural analgesia before 4 cm cervical dilatation were classified as the early epidural group, whereas women who received epidural analgesia at or after 4 cm cervical dilatation were classified as the late epidural group.

The timing of epidural analgesia was based on maternal request and clinical circumstances and was not determined by random allocation.

Data Collection: After obtaining informed consent, relevant demographic, obstetric, intrapartum, anaesthetic and neonatal information was collected using a structured data collection proforma.

The following variables were recorded:

1. Maternal age
2. Parity
3. Gestational age
4. Onset of labour
5. Induction of labour
6. Cervical dilatation at the time of epidural initiation
7. Duration of the first stage of labour

8. Duration of the second stage of labour
9. Total duration of labour
10. Oxytocin augmentation
11. Mode of delivery
12. Instrumental vaginal delivery
13. Caesarean delivery
14. Maternal complications
15. Apgar score at 1 and 5 minutes
16. NICU admission

Assessment of Labour Progress: Labour progression was assessed by serial cervical examinations and routine maternal and fetal monitoring according to institutional obstetric practice.

The first stage of labour was defined as the period from established labour until complete cervical dilatation.

The second stage of labour was defined as the period from complete cervical dilatation until delivery of the fetus.

The total duration of labour was calculated from the onset of established labour until delivery.

Epidural Analgesia: Epidural analgesia was administered by trained anaesthesia personnel according to the institutional obstetric anaesthesia protocol. Maternal vital parameters, including blood pressure, pulse rate and oxygen saturation, were monitored during and following administration. Fetal wellbeing was monitored according to routine intrapartum protocols.

The type and concentration of local anaesthetic, adjuvant drugs, loading dose and maintenance regimen were recorded where applicable according to the anaesthetic record.

Management of Labour: Labour was managed according to the clinical condition of the mother and fetus and institutional obstetric protocols. Oxytocin augmentation was administered when clinically indicated.

The mode of delivery was categorized into:

1. Spontaneous vaginal delivery
2. Instrumental vaginal delivery
3. Caesarean delivery

The indication for instrumental or caesarean delivery was documented where applicable.

Outcome Measures: Primary Outcomes

The primary outcomes were:

- Duration of the first stage of labour.
- Duration of the second stage of labour.
- Mode of delivery.

Secondary Outcomes

The secondary outcomes included:

- Total duration of labour.
- Requirement for oxytocin augmentation.
- Instrumental vaginal delivery.
- Caesarean delivery.
- Maternal hypotension and other maternal complications.
- Apgar score at 1 and 5 minutes.
- NICU admission.

Statistical Analysis: The collected data were entered into a computerized database and analysed using appropriate statistical software.

Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequency and percentage.

Continuous variables between the early and late epidural groups were compared using the independent-samples t-test for normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

A two-sided p value <0.05 was considered statistically significant. Where appropriate, effect estimates with 95% confidence intervals were also reported.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee of DMCH. Written informed consent was obtained from all participants before enrolment. Confidentiality and privacy of the participants were maintained throughout the study, and the collected information was used only for research purposes.

Results

Baseline Characteristics: A total of 100 women were included in the study, with 50 participants in the early epidural group and 50 in the late epidural group. The baseline demographic and obstetric characteristics of the participants are presented in Table 1.

The mean maternal age was comparable between the early and late epidural groups (25.8 ± 3.1 vs 26.1 ± 3.3 years, respectively; $p = 0.64$). Similarly, mean gestational age did not differ significantly between the groups (39.0 ± 1.0 vs 39.1 ± 0.9 weeks; $p = 0.58$). Primigravida women constituted 64.0% of the early epidural group and 62.0% of the late epidural group, while multigravida women constituted 36.0% and 38.0%, respectively ($p = 0.83$). The proportion of women undergoing induced labour was also comparable between the groups (42.0% vs 40.0%; $p = 0.84$). Overall, no statistically significant differences were observed in the baseline demographic or obstetric characteristics between the two groups.

Table 1.:Baseline demographic and obstetric characteristics of study participants

Variable	Early epidural (n=50)	Late epidural (n=50)	p-value
Maternal age (years), mean $\pm$ SD	25.8 $\pm$ 3.1	26.1 $\pm$ 3.3	0.64
Gestational age (weeks), mean $\pm$ SD	39.0 $\pm$ 1.0	39.1 $\pm$ 0.9	0.58
Primigravida, n (%)	32 (64.0)	31 (62.0)	0.83
Multigravida, n (%)	18 (36.0)	19 (38.0)	0.83
Induced labour, n (%)	21 (42.0)	20 (40.0)	0.84
Spontaneous labour, n (%)	29 (58.0)	30 (60.0)	0.84

Labour Characteristics: The comparison of intrapartum characteristics between the two groups is shown in Table 2. As expected from the predefined classification, the mean cervical dilatation at the time of epidural initiation was significantly lower in the early epidural group than in the late epidural group (2.8 ± 0.6 vs 5.1 ± 0.9 cm, respectively; $p < 0.001$).

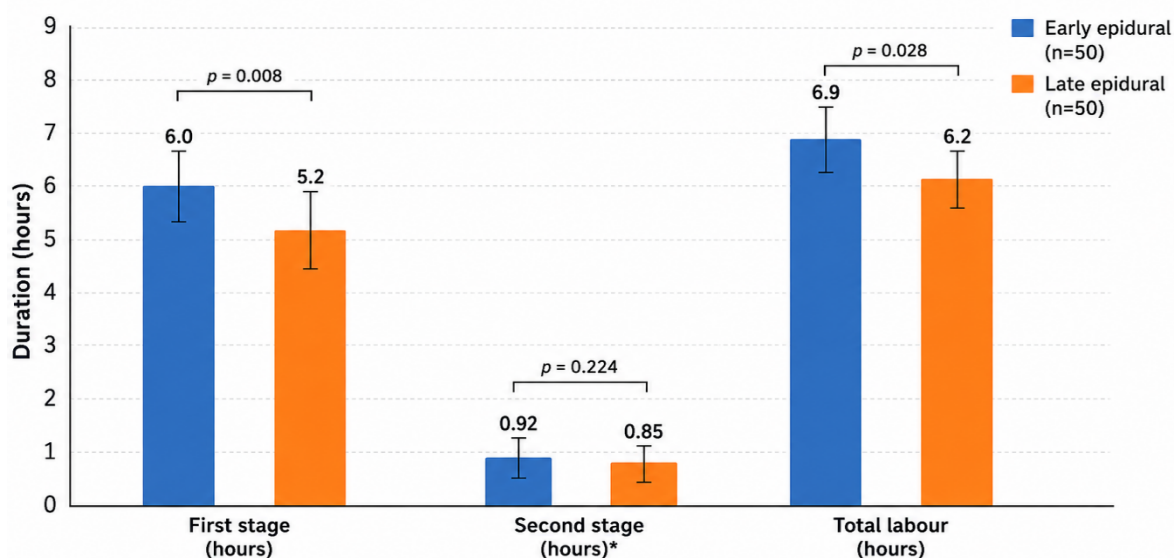
The mean duration of the first stage of labour was significantly longer among women who received early epidural analgesia compared with those who received late epidural analgesia (6.0 ± 1.5 vs 5.2 ± 1.4 hours; $p = 0.008$). As illustrated in Figure 1, the absolute difference in mean first-stage duration was 0.8 hours.

The mean duration of the second stage was also longer in the early epidural group (55.2 ± 18.1 vs 51.0 ± 16.4 minutes); however, this difference was not statistically significant ($p = 0.224$). The total duration of labour was significantly longer in the early epidural group (6.9 ± 1.6 vs 6.2 ± 1.5 hours; $p = 0.028$), corresponding to a mean difference of 0.7 hours.

Oxytocin augmentation was required in 28 (56.0%) women in the early epidural group compared with 22 (44.0%) women in the late epidural group. Although augmentation was numerically more frequent in the early group, the difference was not statistically significant ($p = 0.230$).

Table 2: Comparison of labour characteristics according to timing of epidural analgesia

Variable	Early epidural (n=50)	Late epidural (n=50)	p-value
Cervical dilatation at epidural initiation (cm), mean $\pm$ SD	2.8 $\pm$ 0.6	5.1 $\pm$ 0.9	<0.001
First-stage duration (hours), mean $\pm$ SD	6.0 $\pm$ 1.5	5.2 $\pm$ 1.4	0.008
Second-stage duration (minutes), mean $\pm$ SD	55.2 $\pm$ 18.1	51.0 $\pm$ 16.4	0.224
Total labour duration (hours), mean $\pm$ SD	6.9 $\pm$ 1.6	6.2 $\pm$ 1.5	0.028
Oxytocin augmentation, n (%)	28 (56.0)	22 (44.0)	0.230

Figure 1. Labour duration according to timing of epidural analgesia

* Second-stage duration was converted from minutes to hours for graphical presentation.

Figure 1. Mean duration of the first stage, second stage, and total labour according to timing of epidural analgesia. The first stage and total labour duration were significantly longer in the early epidural group, whereas the difference in second-stage duration was not statistically significant. Data derived from Table 2.

Figure 1. Mean duration of the first stage, second stage, and total labour according to timing of epidural analgesia.

Mode of Delivery: The distribution of mode of delivery is presented in Table 3 and Figure 2. Spontaneous vaginal delivery was the most common mode of delivery in both groups, occurring in 39 (78.0%) women in the early epidural group and 41 (82.0%) women in the late epidural group. This difference was not statistically significant ($p = 0.616$).

Instrumental vaginal delivery occurred in 5 (10.0%) women in the early epidural group and 4 (8.0%) women in the late epidural group ($p = 0.727$). Caesarean delivery occurred in 6 (12.0%) and 5 (10.0%) women, respectively ($p = 0.749$). Thus, there was no statistically significant difference in the overall distribution of mode of delivery between the two groups (Table 3; Figure 2).

Table 3: Mode of delivery according to timing of epidural analgesia

Mode of delivery	Early epidural (n=50), n (%)	Late epidural (n=50), n (%)	p-value
Spontaneous vaginal delivery	39 (78.0)	41 (82.0)	0.616
Instrumental vaginal delivery	5 (10.0)	4 (8.0)	0.727
Caesarean delivery	6 (12.0)	5 (10.0)	0.749
Total	50 (100)	50 (100)	—

Figure 2. Mode of delivery according to timing of epidural analgesia

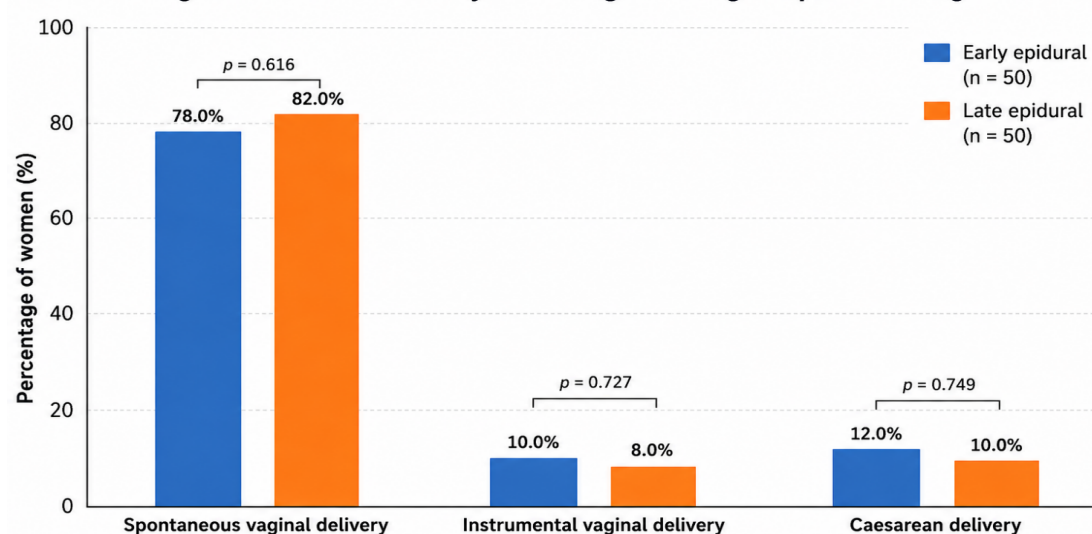


Figure 2. Distribution of mode of delivery according to timing of epidural analgesia. The proportions of spontaneous vaginal, instrumental vaginal, and caesarean deliveries were comparable between women receiving early and late epidural analgesia. Data are presented as percentages of women in each group. Data derived from Table 3.

Figure 2: Distribution of mode of delivery according to timing of epidural analgesia.

Maternal and Neonatal Outcomes: Maternal and neonatal outcomes are summarized in Table 4 and Figure 3. Maternal hypotension occurred in 4 (8.0%) women in the early epidural group and 3 (6.0%) women in the late epidural group ($p = 0.695$). Nausea or vomiting occurred in 3 (6.0%) and 2 (4.0%) women, respectively ($p = 0.645$).

An Apgar score <7 at 1 minute was observed in 2 (4.0%) neonates in the early epidural group and 1 (2.0%) neonate in the late epidural group ($p =$

0.557). An Apgar score <7 at 5 minutes occurred in 1 (2.0%) neonate in the early group and none in the late group ($p = 0.315$). NICU admission was required for 2 (4.0%) and 1 (2.0%) neonates, respectively ($p = 0.557$).

As shown in Figure 3, the absolute differences in these maternal and neonatal outcomes were small, and none of the evaluated outcomes differed significantly between the two groups (Table 4; Figure 3).

Table 4: Maternal and neonatal outcomes according to timing of epidural analgesia

Outcome	Early epidural (n=50), n (%)	Late epidural (n=50), n (%)	p-value
Maternal hypotension	4 (8.0)	3 (6.0)	0.695
Nausea/vomiting	3 (6.0)	2 (4.0)	0.645
Apgar <7 at 1 minute	2 (4.0)	1 (2.0)	0.557
Apgar <7 at 5 minutes	1 (2.0)	0 (0)	0.315
NICU admission	2 (4.0)	1 (2.0)	0.557

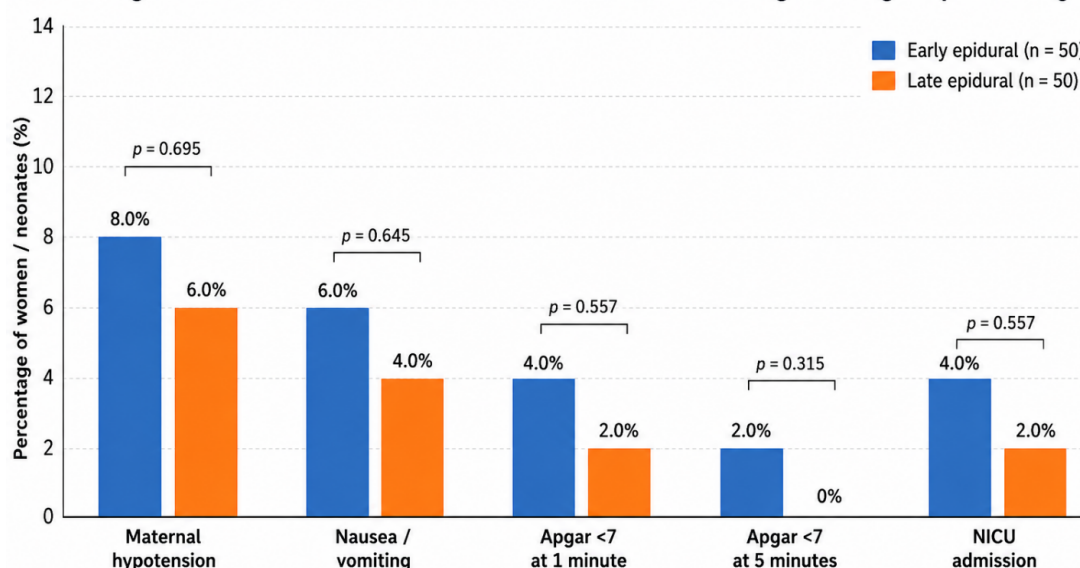
Figure 3. Selected maternal and neonatal outcomes according to timing of epidural analgesia

Figure 3. Selected maternal and neonatal outcomes according to timing of epidural analgesia. Maternal hypotension, nausea/vomiting, Apgar score <7 at 1 and 5 minutes, and NICU admission were uncommon in both groups. No statistically significant differences were observed between the early and late epidural groups. Data are presented as percentages of women/neonates, as applicable. Data derived from Table 4.

Figure 3: Selected maternal and neonatal outcomes according to timing of epidural analgesia.

Overall Findings: Overall, the study demonstrated that early epidural analgesia was associated with a significantly longer first stage and total duration of labour, while the difference in second-stage duration was not statistically significant. Despite the longer labour duration, no statistically significant difference was observed in spontaneous vaginal, instrumental vaginal, or caesarean delivery rates. Similarly, the evaluated maternal and neonatal outcomes were comparable between the two groups.

Discussion

The present prospective observational study evaluated the association between the timing of epidural analgesia and labour progression and mode of delivery. In this cohort of 100 women, early epidural analgesia, defined as initiation before 4 cm cervical dilatation, was associated with a significantly longer first stage and total duration of labour compared with late epidural analgesia. However, no statistically significant differences were observed in the duration of the second stage, oxytocin augmentation, spontaneous vaginal delivery, instrumental vaginal delivery or caesarean delivery. Maternal and neonatal outcomes were also comparable between the two groups.

The significantly longer first stage observed in the early epidural group is compatible with the historical concern that neuraxial analgesia may influence labour progression. Earlier reviews described associations between epidural analgesia and prolongation of labour, as well as an increased frequency of operative vaginal delivery, although the relationship with caesarean delivery was less

consistent [2,3]. These earlier observations contributed to the traditional practice of delaying epidural analgesia until a particular degree of cervical dilatation had been reached. However, such observational associations are difficult to interpret because the timing of epidural administration may be influenced by the underlying course of labour and other maternal or obstetric factors.

Evidence from randomized controlled trials provides a different perspective regarding the relationship between the timing of neuraxial analgesia and mode of delivery. Wong et al. studied 750 nulliparous women and found that early neuraxial analgesia did not increase the risk of caesarean delivery compared with delayed neuraxial analgesia [4]. These findings are relevant to the present study because, despite the longer first-stage duration observed with early epidural analgesia, the caesarean delivery rate was not significantly different between the early and late groups. In the present study, caesarean delivery occurred in 12% of women in the early group and 10% in the late group ($p = 0.749$).

Similarly, Chestnut et al. evaluated early administration of epidural analgesia in nulliparous women in spontaneous labour and found no evidence of an adverse effect on obstetric outcome [5]. The present findings are consistent with this observation, as early epidural administration was not associated with a statistically significant increase in instrumental or caesarean delivery. Instrumental vaginal delivery occurred in 10% of women in the early group compared with 8% in the late group,

while spontaneous vaginal delivery occurred in 78% and 82%, respectively.

The timing of neuraxial analgesia has also been investigated in women undergoing induction of labour. Wong et al. compared early neuraxial analgesia with a strategy of initial systemic opioid analgesia followed by later epidural analgesia in nulliparous women undergoing induction [6]. Early neuraxial analgesia did not increase the rate of caesarean delivery. This finding is particularly relevant to the interpretation of the present study because induced labour was present in 42% of women in the early group and 40% in the late group. Although the proportions were comparable, induction remains a potential determinant of labour duration and should be considered when interpreting the observed difference in first-stage duration.

A large randomized controlled trial by Wang et al. further examined epidural analgesia administered during the latent phase of labour in nulliparous women [7]. Early epidural analgesia did not increase the risk of caesarean delivery compared with delayed administration. The results of this large trial provide further evidence that withholding neuraxial analgesia during early labour solely to reduce the risk of caesarean delivery is not supported by randomized evidence. The absence of a significant difference in caesarean delivery in the present study is therefore consistent with the findings of previous randomized studies.

The Cochrane review by Anim-Somuah et al. evaluated epidural versus non-epidural or no analgesia for pain management during labour and demonstrated that epidural analgesia provides effective pain relief, without a clear increase in caesarean delivery [1]. These findings support the use of neuraxial analgesia when requested by women, while also emphasizing that the potential effects of epidural analgesia on labour duration and operative vaginal delivery should be considered separately from its effect on caesarean delivery.

The technique used for epidural analgesia may also be relevant when interpreting obstetric outcomes. Wang et al. reported in a systematic review and meta-analysis that low-concentration local anaesthetic epidural techniques were not associated with significant adverse obstetric outcomes, including instrumental birth, caesarean delivery, spontaneous vaginal delivery or prolongation of the second stage [8]. Modern low-concentration techniques are designed to provide effective analgesia while minimizing motor blockade. Therefore, findings from older studies using techniques associated with greater motor blockade may not be directly applicable to contemporary epidural practice.

In the present study, the second stage of labour was slightly longer in the early epidural group than in the late group, with mean durations of 55.2 ± 18.1 and 51.0 ± 16.4 minutes, respectively. However, this difference was not statistically significant ($p = 0.224$). This finding is consistent with evidence suggesting that modern neuraxial analgesia does not necessarily result in clinically important prolongation of the second stage. Importantly, the duration of the second stage is influenced by several factors, including parity, fetal size and position, station, oxytocin use and the management of pushing [11]. Consequently, differences in second-stage duration cannot necessarily be attributed to the timing of epidural initiation alone.

Management of pushing is another factor that may influence the duration of the second stage among women receiving neuraxial analgesia. Di Mascio et al., in a systematic review and meta-analysis of randomized controlled trials, found that delayed pushing reduced the duration of active pushing but increased the overall duration of the second stage, without demonstrating a clear improvement in mode of delivery [9]. This evidence highlights the importance of considering intrapartum management practices when evaluating the relationship between neuraxial analgesia and labour duration.

In the present study, total labour duration was significantly longer in the early epidural group, with a mean duration of 6.9 ± 1.6 hours compared with 6.2 ± 1.5 hours in the late group ($p = 0.028$). The difference in total duration is likely to be influenced substantially by the longer first stage observed in the early group. However, because epidural timing was not randomly assigned, it is not possible to determine whether earlier epidural administration itself prolonged labour. Women who request analgesia at an earlier stage may differ in pain perception, labour pattern, cervical progression or other clinical characteristics from women who request analgesia later. Thus, the observed association should not be interpreted as evidence of a causal effect of early epidural analgesia on labour duration.

Oxytocin augmentation was more frequently required in the early epidural group than in the late group (56% versus 44%), although the difference was not statistically significant ($p = 0.230$). This finding should also be interpreted cautiously. Oxytocin use may be influenced by cervical progress, uterine activity and other clinical factors. Furthermore, women with slower or more painful labour may request epidural analgesia earlier and may simultaneously be more likely to require augmentation. Therefore, the relationship between early epidural administration and oxytocin use may reflect confounding by the underlying labour course rather than a direct effect of epidural analgesia.

The mode of delivery findings are clinically important. Although spontaneous vaginal delivery was slightly less frequent in the early group than in the late group (78% versus 82%), this difference was not statistically significant. Similarly, instrumental delivery occurred in 10% versus 8%, and caesarean delivery in 12% versus 10%, with no statistically significant differences between groups. These findings are consistent with randomized evidence showing that early neuraxial analgesia does not appear to increase the risk of caesarean delivery [4-7]. However, the relatively small sample size of the present study limits the ability to detect small differences in uncommon outcomes such as instrumental and caesarean delivery.

Maternal and neonatal outcomes were also comparable between the two groups. Maternal hypotension occurred in 8% of women in the early group and 6% in the late group, while nausea or vomiting occurred in 6% and 4%, respectively. Similarly, the proportions of neonates with Apgar scores below 7 at one and five minutes and NICU admission were low and did not differ significantly between groups. These findings are reassuring, although the small number of events means that the study has limited statistical power to evaluate uncommon maternal or neonatal complications.

The present findings should also be interpreted in the context of contemporary recommendations. The World Health Organization recommends epidural analgesia as an option for women requesting pain relief during labour, with consideration of individual preferences and clinical circumstances [10]. Current ACOG guidance likewise supports offering neuraxial analgesia for maternal request during labour and does not require a specific cervical dilatation threshold before analgesia is provided [11]. Thus, the use of a 4-cm threshold in the present study should be understood as an **operational definition for study-group classification**, rather than as a recommendation that epidural analgesia should be withheld before 4 cm cervical dilatation.

The distinction between the study's operational definition and contemporary labour management is important. Historically, 4 cm cervical dilatation was commonly used as a marker of the beginning of active labour. Current ACOG guidance considers approximately 6 cm cervical dilatation to represent the beginning of the active phase [11]. Nevertheless, cervical dilatation at epidural initiation remains a useful variable for examining the timing of analgesia in an observational study, provided that the cutoff is clearly identified as a study definition rather than a clinical requirement.

Overall, the present study demonstrates an association between early epidural analgesia and longer first-stage and total labour duration, but does not demonstrate an association with increased

operative delivery. This apparent difference from some historical concerns is consistent with contemporary evidence suggesting that the timing of neuraxial analgesia does not meaningfully alter the risk of caesarean delivery [1,4-8]. The longer labour duration observed in the present study may reflect differences in the underlying labour course and other unmeasured or uncontrolled confounding factors rather than a direct effect of early epidural administration.

The principal limitation of the present study is its observational design. Participants were not randomly allocated to early or late epidural analgesia, and therefore causal relationships cannot be established. Although parity and induction status were comparable between the groups, other factors such as cervical dilatation at admission, maternal body mass index, fetal position, fetal birth weight, labour pattern and indications for oxytocin augmentation may have influenced the outcomes. In addition, the sample size was relatively small and the study was conducted at a single institution, which may limit generalizability.

Despite these limitations, the study provides prospective institutional data on a clinically relevant question. The findings suggest that early epidural analgesia, when requested by the mother and clinically appropriate, was not associated with a statistically significant increase in instrumental or caesarean delivery in this cohort. The observed longer duration of the first and total stages should be interpreted as an **association rather than a causal effect**. Larger multicentre prospective studies incorporating multivariable adjustment for parity, induction, cervical dilatation at admission, oxytocin use and relevant maternal and fetal factors would help clarify the independent relationship between timing of epidural analgesia and labour progression.

Strengths of the Study

The prospective design allows systematic collection of maternal, obstetric and neonatal information.

The study specifically evaluates the clinically important question of timing of epidural analgesia and includes both labour progression and mode of delivery as outcomes.

The study also considers maternal and neonatal outcomes, providing a broader assessment of the safety of early versus late epidural analgesia.

Limitations: The sample size of 100 participants is relatively small and may limit the ability to detect differences in uncommon outcomes.

The observational design prevents definitive conclusions regarding causality. Women were not randomly allocated to early or late epidural analgesia, and therefore confounding by maternal

characteristics, labour pattern and clinical indication is possible.

Parity, induction of labour, oxytocin use, cervical dilatation at admission, fetal position, maternal body mass index and birth weight may all influence labour duration and mode of delivery.

The study was conducted at a single institution, which may limit generalizability.

Conclusion

In this prospective observational study of 100 women, early epidural analgesia was associated with a modestly longer first stage and total duration of labour compared with late epidural analgesia. However, early administration was not associated with a statistically significant increase in instrumental or caesarean delivery.

The findings are consistent with evidence from randomized trials and systematic reviews indicating that early neuraxial analgesia does not independently increase the risk of caesarean delivery.

Therefore, the timing of epidural analgesia should primarily be individualized according to maternal request, clinical circumstances and availability of appropriate anaesthetic and obstetric care rather than being determined solely by a fixed cervical dilatation threshold.

Further multicentre prospective studies involving larger populations and adjustment for important confounding variables are warranted.

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