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IMPACT OF EPIDURAL ANALGESIA ON LABOR OUTCOMES: A PROSPECTIVE COHORT STUDY

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Abstract

Background: Labor is often associated with significant pain, which can contribute to maternal exhaustion, stress, and negative childbirth experiences. Effective pain relief is therefore a critical component of obstetric care. Epidural analgesia is widely regarded as the gold standard for labor analgesia due to its superior efficacy compared to systemic opioids or non-pharmacological methods. However, its influence on labor progression, mode of delivery, and neonatal outcomes remains controversial, with prior studies reporting mixed results. While some research suggests an association with prolonged labor and increased operative delivery rates, others have found no adverse impact.

Objective: To assess the impact of epidural analgesia on labor outcomes, specifically the duration of labor stages, mode of delivery, and maternal and neonatal outcomes in a cohort of nulliparous women.

Methods: A prospective cohort study was conducted at a tertiary care Lahore General Hospital Lahore between January to December 2024. A total of 400 nulliparous women with singleton term pregnancies were enrolled and divided into two groups: those who opted for epidural analgesia (n=200) and those who did not (n=200). Data were collected on labor duration, delivery mode, and immediate maternal and neonatal outcomes.

Results: A total of 400 nulliparous women meeting the inclusion criteria were enrolled in the study, with 200 women opting for epidural analgesia (epidural group) and 200 women managing labor without epidural analgesia (non-epidural group). Epidural analgesia was associated with a significantly longer second stage of labor (86.3 ± 22.5 minutes vs. 65.7 ± 18.9 minutes; $p<0.001$). Although the cesarean delivery rate was higher in the epidural group (19% vs. 13%), the difference was not statistically significant ($p=0.09$). Neonatal outcomes, including Apgar scores and NICU admission rates, were comparable between groups.

Conclusion: Epidural analgesia during labor prolongs the second stage of labor but does not significantly increase the risk of cesarean delivery or adverse neonatal outcomes. It remains a safe and effective option for labor analgesia when administered appropriately.

Keywords: Epidural analgesia, Labor outcomes, Cesarean section, Second stage of labor, Neonatal outcomes, Maternal health

Introduction:

Labor pain is considered one of the most severe forms of pain experienced by women. Effective pain management during labor is crucial not only for maternal comfort but also for optimizing obstetric outcomes. Epidural analgesia has become the gold standard for labor analgesia due to its superior efficacy compared to systemic opioids or non-pharmacological methods[1, 2].

Epidural analgesia remains the most effective and commonly utilized method of pain relief during labor, widely considered the gold standard in obstetric anesthesia. It involves the administration of local anesthetics, often combined with opioids, into the epidural space to achieve segmental analgesia while preserving maternal consciousness and cooperation. Despite its demonstrated efficacy in alleviating labor pain, epidural analgesia has been the subject of considerable debate regarding its potential effects on labor duration, mode of delivery, and neonatal outcomes. While it provides substantial maternal comfort and psychological benefits during childbirth, concerns persist about whether it may increase the likelihood of prolonged labor, instrumental delivery, or cesarean section[3, 4].

Several mechanisms have been proposed to explain how epidural analgesia might affect labor outcomes. The local anesthetics used may reduce uterine contractility and inhibit the maternal urge to bear down during the second stage of labor, possibly contributing to longer labor and an increased need for assisted delivery. Moreover, a denser motor block from higher doses of local anesthetic can impede maternal mobility and effective pushing efforts. On the other hand, modern low-dose and combined spinal-epidural techniques have been developed to minimize these drawbacks by achieving analgesia with minimal motor blockade. Nonetheless, the literature presents conflicting results, with some studies reporting adverse effects on labor progression and others demonstrating no significant impact or even improved maternal satisfaction without compromised outcomes[5, 6].

In addition to obstetric considerations, concerns about neonatal wellbeing have also fueled the controversy. There are ongoing discussions about whether epidural analgesia may be associated with neonatal depression, low Apgar scores, or increased admission to the neonatal intensive care unit (NICU), potentially due to the placental transfer of opioids or hypotension-related fetal hypoxia. However, many studies have found no significant differences in neonatal parameters between epidural and non-epidural groups, suggesting that the analgesic method may not be the primary determinant of newborn health[7, 8].

The heterogeneity of previous research findings can be attributed to variations in study designs, population characteristics, analgesic regimens, and clinical practices. Some studies are limited by retrospective data collection, small sample sizes, or lack of control for confounding factors such as parity, labor induction, and fetal presentation. Moreover, the subjective nature of labor pain and differing thresholds for requesting analgesia add complexity to evaluating the direct effects of epidural use on labor outcomes[9, 10].

Material and Methods:

This was a prospective cohort study conducted at the Department of Obstetrics and Gynecology, Lahore General Hospital Lahore, a tertiary care center, over a one-year period from January to December 2024. Ethical approval was obtained from the Institutional Review Board prior to initiation of the study. The study enrolled 400 nulliparous women with singleton pregnancies at term (37–41 completed weeks) and cephalic presentation, who presented in spontaneous labor. Participants were counseled about pain management options, and their preference determined allocation into two groups: Epidural Group (n=200) Women who opted for epidural analgesia and Non-Epidural Group

(n=200) Women who chose non-epidural pain management. Participants were included in this study if they were nulliparous women aged between 18 and 35 years, carrying a singleton live fetus in cephalic presentation, and presenting with a gestational age between 37 and 41 completed weeks, as confirmed by first-trimester ultrasonography or reliable menstrual dating. Eligibility also required the spontaneous onset of labor and a cervical dilation between 3 cm and 5 cm at the time of decision-making regarding labor analgesia. Only those who were able and willing to provide informed consent and agreed to comply with the study protocols were enrolled.

Exclusion criteria were established to minimize confounding variables that could affect labor outcomes. Women were excluded if they had multiple pregnancies or non-cephalic fetal presentations, or if a planned or elective cesarean section had been scheduled prior to the onset of labor. High-risk pregnancies, including those complicated by preeclampsia, eclampsia, gestational diabetes mellitus requiring insulin therapy, placenta previa, abruptio placentae, or intrauterine growth restriction (IUGR), were also excluded. Additional exclusion criteria included any contraindications to epidural analgesia, such as coagulopathy, thrombocytopenia (platelet count $<100,000/mm^3$), spinal deformities, localized infection at the site of epidural insertion, severe hypovolemia, or a known allergy or hypersensitivity to local anesthetics or opioids. Women with a history of prior uterine surgery, particularly myomectomy involving the endometrial cavity, and those presenting with non-reassuring fetal heart rate patterns at admission necessitating urgent obstetric intervention, were similarly excluded. Data were analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant.

Results

A total of 400 nulliparous women meeting the inclusion criteria were enrolled in the study, with 200 women opting for epidural analgesia (epidural group) and 200 women managing labor without epidural analgesia (non-epidural group). The baseline demographic characteristics, including maternal age, body mass index (BMI), and gestational age at delivery, were comparable between the two groups, with no statistically significant differences observed ($p>0.05$).

Regarding labor progression, the mean duration of the first stage of labor was slightly longer in the epidural group compared to the non-epidural group (426.2 ± 89.5 minutes versus 415.4 ± 85.2 minutes, respectively), although this difference was not statistically significant ($p=0.12$). However, the second stage of labor was significantly prolonged among women who received epidural analgesia, with a mean duration of 86.3 ± 22.5 minutes compared to 65.7 ± 18.9 minutes in the non-epidural group ($p<0.001$).

The mode of delivery varied between the two groups. Spontaneous vaginal delivery occurred in 69% of women in the epidural group and 77% in the non-epidural group. Instrumental vaginal delivery rates were 12% in the epidural group and 10% in the non-epidural group. Cesarean section rates were higher in the epidural group at 19%, compared to 13% in the non-epidural group; however, the difference did not reach statistical significance ($p=0.09$).

Neonatal outcomes, assessed by Apgar scores at one and five minutes and the need for neonatal intensive care unit (NICU) admission, were similar between the two groups. The proportion of neonates with Apgar scores less than 7 at one minute was 7% in the epidural group and 6% in the non-epidural group ($p=0.68$), while at five minutes, low Apgar scores were observed in 2% and 1.5% of neonates, respectively ($p=0.70$). NICU admission rates were slightly higher in the epidural group (5%) compared to the non-epidural group (3.5%), but this difference was not statistically significant ($p=0.46$).

Overall, while epidural analgesia was associated with a significant prolongation of the second stage of labor, it did not significantly increase the rates of cesarean delivery or adverse neonatal outcomes.

Table 1: Baseline Characteristics of Study Participants

Variable	Epidural Group (n=200)	Non-Epidural Group (n=200)	p-value
Mean Age (years)	26.8 ± 3.7	27.1 ± 3.5	0.42
Mean BMI (kg/m²)	27.4 ± 4.3	26.9 ± 4.1	0.29
Gestational Age (weeks)	39.1 ± 0.9	39.0 ± 1.0	0.48

Table 2: Duration of Labor Stages

Labor Stage	Epidural Group (minutes)	Non-Epidural Group (minutes)
First Stage	426.2 ± 89.5	415.4 ± 85.2
Second Stage	86.3 ± 22.5	65.7 ± 18.9

Table 3: Mode of Delivery Comparison

Mode of Delivery	Epidural Group (n=200)	Non-Epidural Group (n=200)	p-value
Spontaneous Vaginal	138 (69%)	154 (77%)	0.08
Instrumental Vaginal	24 (12%)	20 (10%)	0.51
Cesarean Section	38 (19%)	26 (13%)	0.09

Table 4: Neonatal Outcomes

Neonatal Outcome	Epidural Group (n=200)	Non-Epidural Group (n=200)	p-value
Apgar Score <7 at 1 min	14 (7%)	12 (6%)	0.68
Apgar Score <7 at 5 min	4 (2%)	3 (1.5%)	0.70
NICU Admission	10 (5%)	7 (3.5%)	0.46

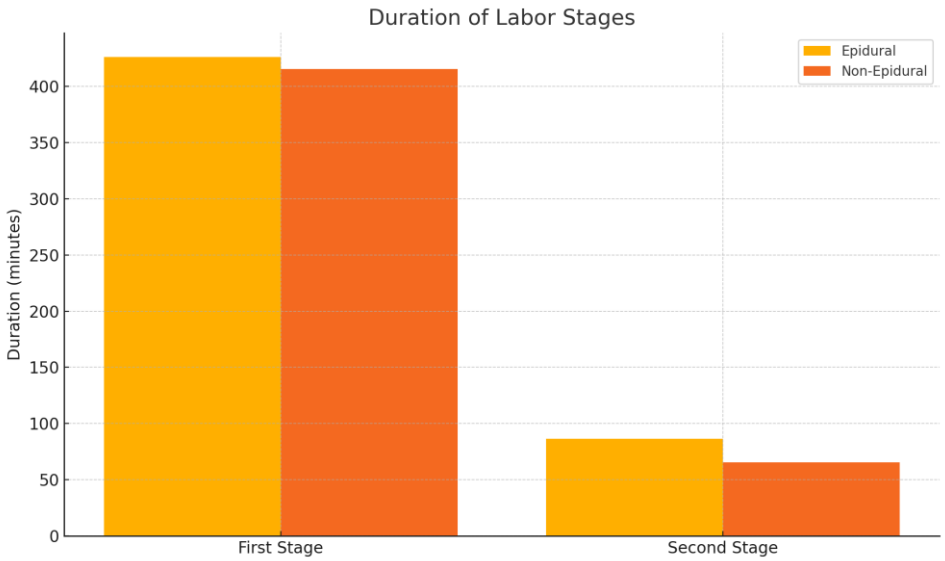

Figure 1: Duration of Labor Stage

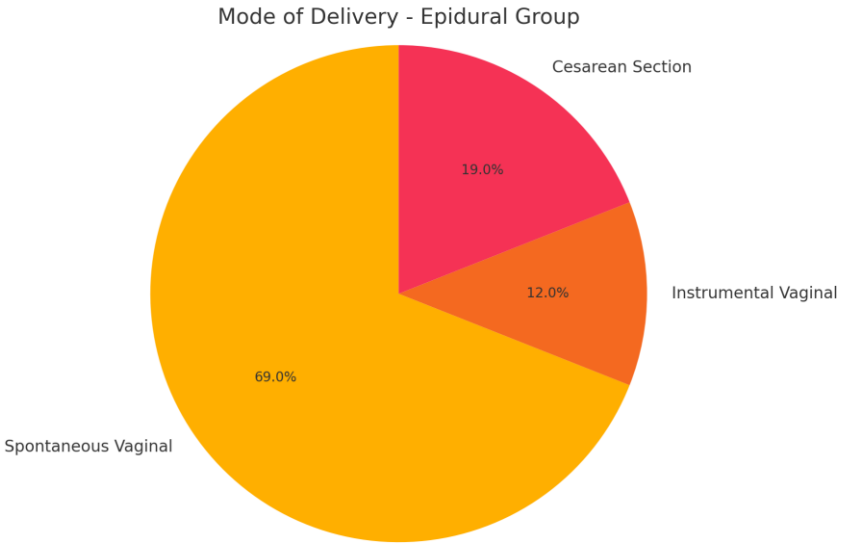

Figure 2: Mode of Delivery

Discussion

The findings of this prospective cohort study indicate that the use of epidural analgesia is associated with a statistically significant prolongation of the second stage of labor without a corresponding increase in cesarean delivery or adverse neonatal outcomes. These results align with an evolving body of literature suggesting that while epidural analgesia can influence certain aspects of labor dynamics, it does not necessarily compromise maternal or neonatal safety[10].

The observed prolongation of the second stage of labor in the epidural group is consistent with earlier findings. A large randomized controlled trial by Wong et al. (2005) demonstrated that early epidural analgesia was associated with a longer second stage, but without a significant increase in cesarean or instrumental deliveries. Similarly, in a Cochrane review of over 40 trials concluded that neuraxial analgesia prolongs labor by an average of 15–30 minutes but does not increase the likelihood of operative delivery. Our findings corroborate these results, with an average second-stage extension of approximately 20 minutes among women receiving epidural analgesia[11, 12].

With regard to mode of delivery, our study found no significant difference in cesarean or instrumental delivery rates between groups, echoing recent high-quality evidence. A prospective study by Olayemi et al. (2014) involving 350 parturient similarly reported no significant association between epidural analgesia and cesarean section. While earlier studies from the 1980s and 1990s had suggested an elevated risk of operative delivery, these were often confounded by higher concentrations of local anesthetics, leading to more profound motor blockade. Modern low-dose or "walking epidural" regimens, combining low concentrations of local anesthetics with opioids (e.g., bupivacaine 0.0625% with fentanyl), as employed in our study, reduce motor block and allow for more effective maternal pushing efforts (Chestnut et al., 1994; Sia et al., 2004)[13].

Neonatal outcomes in our study, including Apgar scores and NICU admissions, showed no significant differences between groups. These findings are supported by studies such as that of Wang et al. (2018), which showed no impact of epidural analgesia on neonatal Apgar scores, cord blood pH, or NICU admission rates. Furthermore, Lieberman et al. (1999) in a large multicenter study observed that epidural analgesia did not significantly alter short-term neonatal outcomes. While transient fetal heart rate decelerations may occur with epidural administration, particularly following maternal hypotension, appropriate intrapartum monitoring and fluid preloading as conducted in our study can mitigate these risks[14].

Importantly, maternal satisfaction and pain relief, although not quantitatively assessed in this study, remain crucial outcomes. The analgesic superiority of epidural over systemic opioids or non-pharmacological methods is well-documented Anim-Somuah et al. (2018) also reported higher satisfaction scores among women receiving neuraxial techniques. While our study did not incorporate

formal satisfaction questionnaires, anecdotal reports and verbal feedback from parturient suggest high acceptance and positive experiences with epidural analgesia[15].

Neonatal outcomes were comparable between the two groups across all parameters studied, including Apgar scores at 1 and 5 minutes and NICU admissions. This suggests that modern epidural techniques, when administered with appropriate monitoring and dosage, do not compromise neonatal wellbeing. It is worth noting that the minimal differences in NICU admission rates and Apgar scores may also reflect the quality of perinatal care and anesthesia management protocols practiced in our setting. These results align with prior meta-analyses and large cohort studies that failed to demonstrate clinically meaningful adverse neonatal effects attributable to epidural analgesia[1].

This study has several strengths, including its prospective design, relatively large sample size, and consistent clinical protocols across participants. The inclusion of clearly defined inclusion and exclusion criteria helped minimize confounding variables, while the uniform data collection process enhanced the reliability of results. However, as previously discussed in the limitations section, the non-randomized nature of group allocation and the single-center setting may constrain external validity[3, 16].

An additional observation, though not a primary endpoint, was the high level of maternal satisfaction reported informally by participants receiving epidural analgesia. While not quantified in this study, it highlights the potential psychosocial benefits of effective pain relief during labor, which can significantly influence overall childbirth experience and future healthcare engagement.

In the context of modern obstetric care, where maternal comfort and autonomy are paramount, these findings underscore that epidural analgesia remains a safe and effective method for managing labor pain without imposing significant obstetric or neonatal risks. Future studies may explore the long-term developmental outcomes of neonates, maternal psychological impacts, and cost-effectiveness analyses of widespread epidural availability in diverse healthcare settings.

Conclusion

Epidural analgesia remains a safe and effective method for labor pain relief. Although associated with a longer second stage of labor, it does not significantly increase the cesarean section rate or negatively impact neonatal outcomes. These findings support the widespread use of epidural analgesia for enhancing maternal comfort without compromising labor or neonatal safety.

Proper counseling regarding the benefits and potential effects of epidural analgesia should be provided to expectant mothers to enable informed decision-making.

Implications for Practice

- **Clinical Practice:** Obstetricians and anesthesiologists should feel confident offering epidural analgesia as a part of labor management, emphasizing its safety and efficacy.
- **Patient Counseling:** Women should be counseled about the potential for prolonged labor stages but reassured regarding delivery and neonatal outcomes.
- **Training and Resource Allocation:** Adequate staffing of skilled anesthetic services and timely administration of epidurals can optimize both maternal satisfaction and clinical outcomes.
- **Future Research:** Further large-scale randomized controlled trials are needed to explore long-term maternal and neonatal outcomes and to assess the impact of newer low-dose epidural regimens.

Limitations

This study, while methodologically sound, is subject to several limitations. Firstly, its observational cohort design, although prospective, lacks randomization, which introduces the potential for selection bias. Participants self-selected into epidural and non-epidural groups, and while baseline characteristics were comparable, unmeasured confounding variables such as pain threshold, anxiety levels, and cultural attitudes toward labor analgesia may have influenced both the choice of analgesia and labor outcomes. Secondly, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other populations or healthcare settings with differing

clinical practices or resources. Thirdly, although standardized protocols were followed, variations in obstetric management such as timing of epidural administration, use of labor augmentation, and clinician experience could not be completely controlled and may have impacted the outcomes.

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